SADJ

SMALL ARMS DEFENSE JOURNAL | VOLUME 13, NUMBER 1 | JAN/FEB 2021

SMALL ARMS DEFENSE JOURNAL

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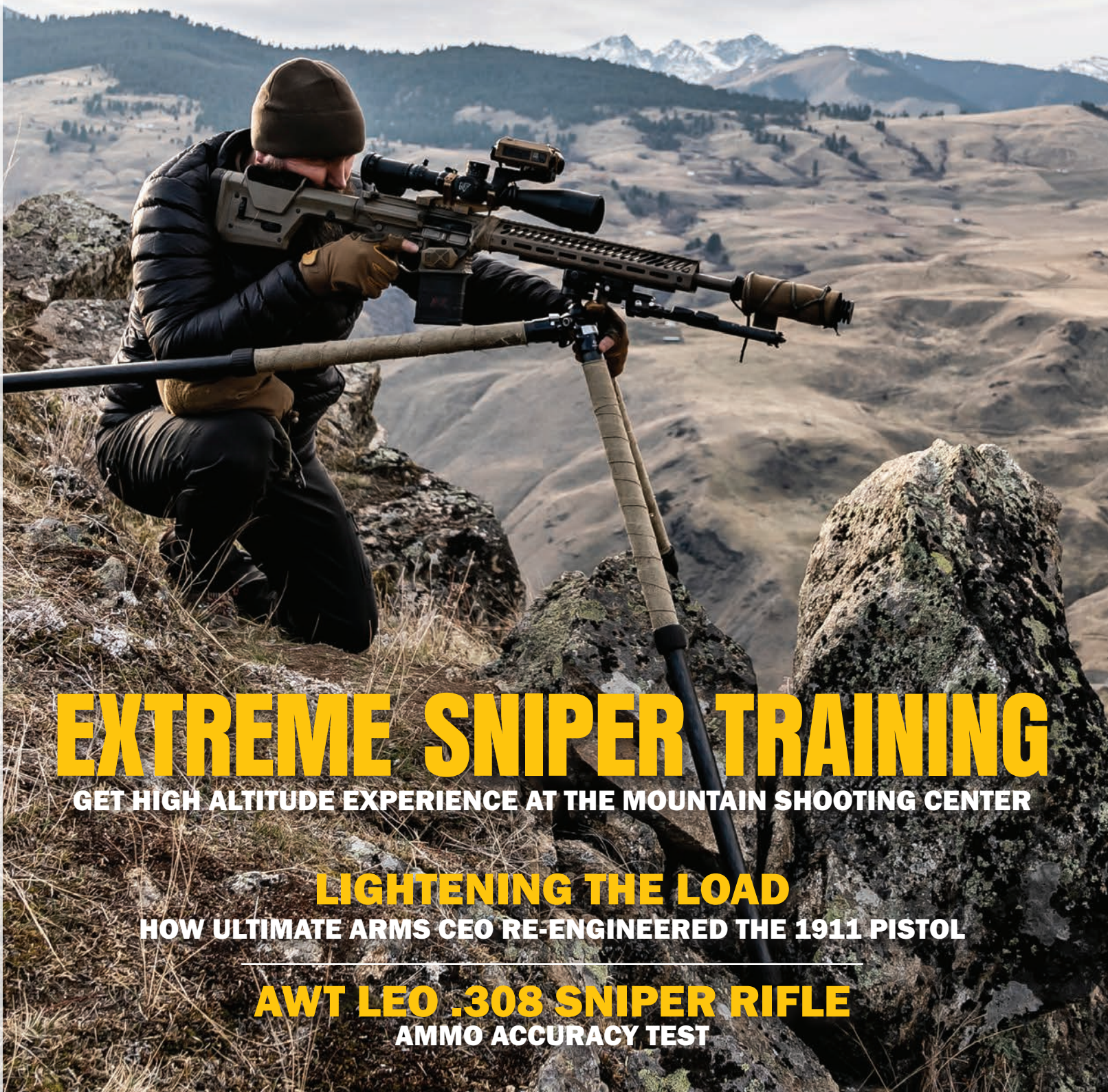

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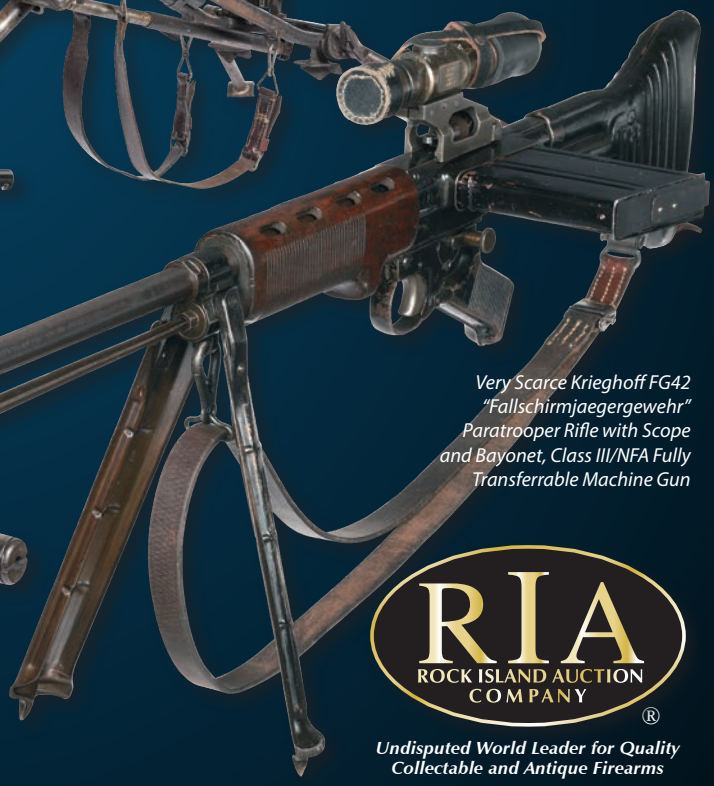

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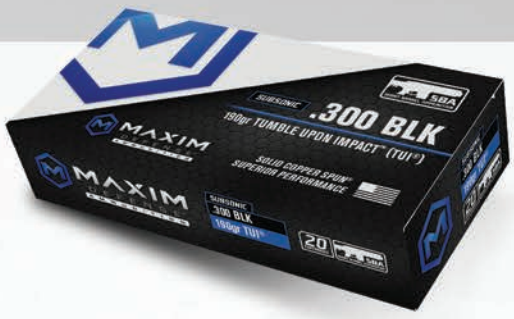

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ON THE COVER

Bryan Morgan at the Hat Creek Training Facility with a **Seekins Precision SP10M, SilencerCo Omega™** Suppressor and **Nightforce®** Optics scope. Other accessories include an **MDT CKYE-POD bipod, Wilcox®** RAPTAR-S LRF and **Really Right Stuff Tripod.**

PHOTO: BEN LA LONDE

See story on page 50.

FEATURES

COLUMNS

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US subscriptions are USD $39.95 for 1 year (6 issues). 1 year international first class is USD $69.95. Subscription prices are subject to change without notice.

NEW PRODUCTS

IWI

Riot Control Portfolio

Israel Weapon Industries (IWI), announced expansion of its portfolio with a comprehensive **riot-control solution**. The newly offered solution uses versatile methods to maintain the public order and safety with minimum force application. These qualities make it suitable for the operational use of law enforcement agencies, military personnel, police units, prison services and riot-control Special Forces.

IWI's riot-control solution, tailored to client's needs, includes conceptual and operative methodology, defensive products such as tactical anti-stab uniforms, anti-stab and bulletproof vests, tactical helmets, shield, multipurpose grenades, offensive tools such as multi-shot 12-gauge shotguns, 37-38mm launcher, 40mm launcher, ammunition, drones and tactical courses for all levels.
iwi.net

LA POLICE GEAR

Tactical Bailout Gear Bag

The LA Police Gear (LAPG) **Bailout Bag** includes features such as: hidden full-size gun pocket with hook and loop; four accessory pockets for gun magazines, etc., with adjustable hook and loop closures; two adjustable side pockets for radios; large main pocket with a removable stiffener/divider system with a loop texture to help organize gear; two pen pockets; and tactical illuminator pocket.

The Bailout Bag fits well with the iPad (all versions) and other similarly sized tablets. The LAPG Bailout Bag will also hold the iPad when it is stowed inside a Hazard 4 Launch MIL-SPEC Sleeve. LAPG's earlier version Bailout Bags are in heavy daily use with: LAPD, San Jose P.D., Santa Clara County Sheriff's Office, San Francisco P.D. and individual officers across the country. The bags were designed to be the ultimate personal gear carry/last resort bailout bag and can serve as a bug out bag and get home bag (GHB).
lapolicegear.com

DIAMOND AGE

Advanced NeoSteel™ Tactical Helmet

Diamond Age, a Texas-based, materials science and engineering firm, has unveiled its latest addition to the tactical helmet market with the new **NeoSteel Helmet,** a modular designed tactical-style helmet comprised of technologically advanced metal alloys. Designed to meet the ever-changing needs of police and military personnel, including reserves and auxiliaries, the NeoSteel Helmet is the result of years of scientific research and development to ensure a high level of ballistic performance (VPAM-3 + Special Threats) at the lightest possible weight with all-day comfort and balance characteristics.

Having undergone rigorous developmental testing for ballistic impact, Diamond Age is proud to announce the NeoSteel Helmet offers best-in-class performance for minimal back-face deformation (BFD) and impact trauma. Unlike current polymer-based helmets, the NeoSteel is also environmentally stable, providing users years of consistent rim-to-rim protection, without material degradation that would severely compromise protection performance.

diamondage.org

NEW PRODUCTS

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When you're looking for Maxim Defense ingenuity in a standard AR-15 package, the **MD-15** is the answer. The MD-15 was engineered to fit the growing demand for reliable, accurate and affordable AR-15 style rifles for today's law enforcement patrol officers. The rifle can be ordered with a 10.5- or 8.5-inch barrel.

Starting at the muzzle, each MD-15 is equipped with the patented Maxim HATEBRAKE™ which reduces recoil, decreases flash signature, pushes gasses and concussion wave downrange away from the operator and improves overall performance in short barrel pistols and rifles. For increased comfort and versatility every MD-15 features Maxim Defense's free-floating Slimline Handguard.
maximdefense.com

LEUPOLD

VX-Freedom AR Rifle Scope Line

Rugged, proven tactical optics from the company that built the award-winning Mark 5HD, the new **VX-Freedom** AR line of optics work with any AR-15 style rifle. The optics feature Mil/Mil adjustments and reticles, exposed 0.1-Mil adjustments, pre-calibrated for .223 Rem but work well for any AR-style rifle or other tactical setup.
leupold.com

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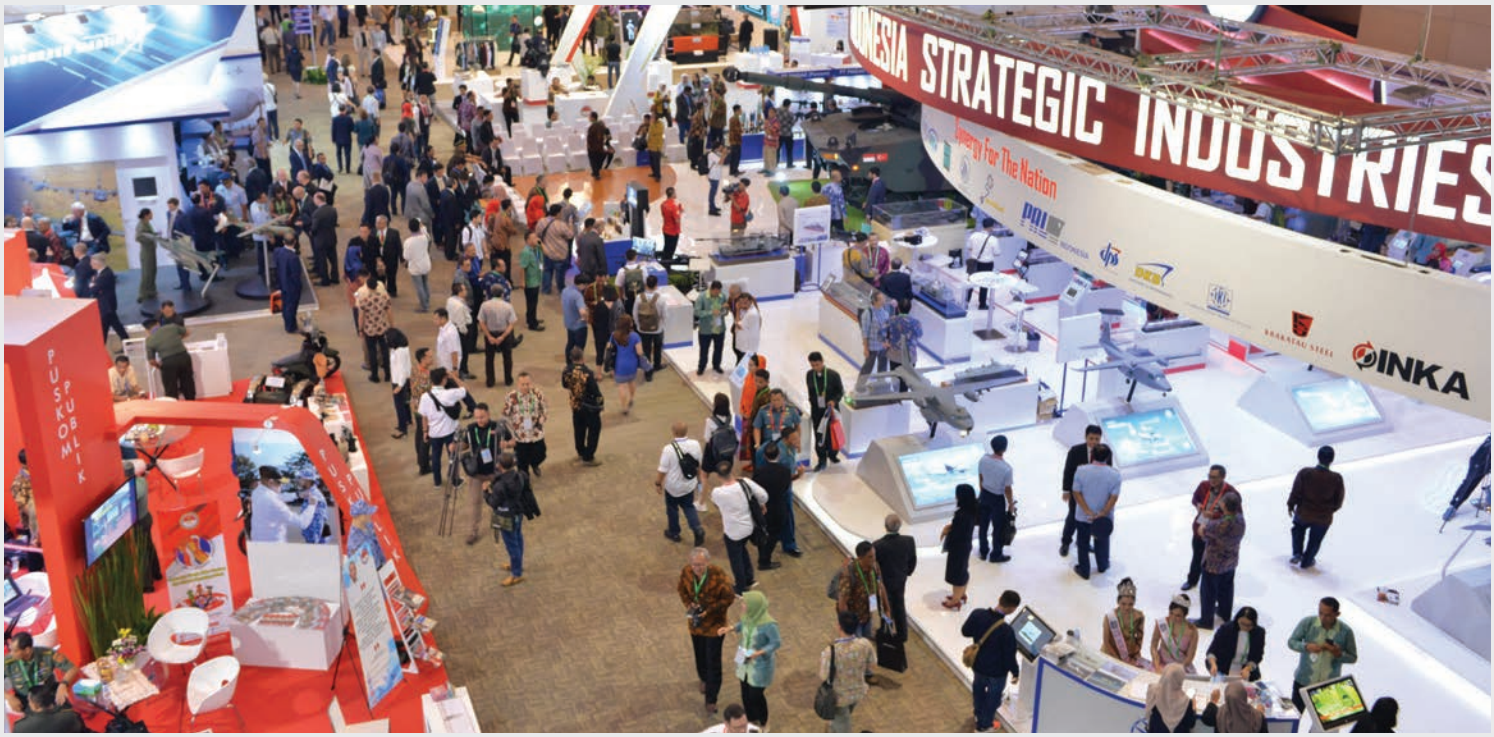

A Place for Opportunities

INDO DEFENCE 2021 Expo & Forum is going to mark its 9th edition on November 2-5, 2022, at Jakarta International Expo (JIExpo) Kemayoran, Jakarta, Indonesia. The Expo is hosted by the Ministry of Defence of the Republic of Indonesia. Held concurrently with the 7th INDO AEROSPACE 2021 Expo & Forum and the 6th INDO MARINE 2021 Expo & Forum, the Expo will be one of the largest defence, aerospace, maritime and security events in the world.

The Expo professionally connects you with the governments, Indonesian Armed Forces, Indonesian national police, associations and reputable partners who can elevate your business opportunities in Indonesia and widely for Southeast Asia market. With a one-stop solution framework, the Expo offers a well-organized exhibition platform alongside international forums and delegation programs, technical product presentations, live demonstrations as well as business matchmaking between the industries or visitors. This international exhibition is expected to be attended by more than 35,000 delegates and trade visitors. Approximately, 1,000 companies from 60 countries will gather in these exhibitions, including 35 country pavilions. We invite official delegations from 84 countries and the high level government officers from Indonesia Procurement Authorities.

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The Expo is going to present the attendance of leading companies: Team Defence Australia, Excalibur, Roketsan, FNSS and Hytera have been signed up their participation, followed by lineup of Indonesia's industry including Sri Rejeki Isman (Sritex), Ridho Agung Mitra Abadi, Jala Berikat Nusantara Perkasa, InfoGlobal Teknologi Semesta, Panorama Graha Teknologi, Multi Integra and Rajawali Lintas Kreasi.

The organizer gives a dedicated spotlight to feature the latest products and innovations shown at our NEW Zones and Highlight: Military Medicine Zone, New Innovation Zone, Defence Security Zone and Thematic Technical Product Presentation for Army, Navy, Air Force and Security.

For 4 action-packed days, visitors will have the opportunity to attend the international forum, free technical product presentations by exhibitors, live product demonstrations and network with industry experts. Visitors can also pre-arrange meetings with exhibitors through the event business matchmaking program. SADJ

2021 SHOW INFORMATION

Host: Ministry of Defence of the Republic of Indonesia
Venue: Jakarta International Expo (JIExpo) Kemayoran, Jakarta, Indonesia
Websites: indodefence.com
indoaerospace.com
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Pitbull Tactical

Universal Magazine Carrier

Story and Photography by Oleg Volk

No more looking for pouches for obsolete or oddball magazines.

Some people carry the same sidearm every day, but it's a lot more common to have a gun for the great outdoors, another for daily wear and a third for socially non-permissive situations. Some people alternate inside the waistband (IWB) and outside the waistband (OWB) carry depending on the garment in use. All those solutions call for different magazine carriers. Pitbull Tactical® (**pitbulltactical.com**) solved this problem with their Universal Mag Carrier.

The Universal Mag Carrier is a clamshell design made of molded plastic halves. They are retained with a sleeve of tough rubber. Wearable inside or outside the waistband, the

The Universal Mag Carrier in use OWB at the range.

Pitbull Tactical's Universal Mag Carriers come in all colors, with the reinforcement ridges and belt clips visible.

carrier is retained with a wide integral belt clip. Inside, the clamshell is ribbed for rigidity. Available in black, green and tan, the carrier holds anything from a compact 380 single-stack to a double-stack submachine gun magazine. MPX and MP5 magazines fit well and do not at all wobble despite their length. The magazine just has to be smaller than a full-size, rifle-caliber box, larger than a subcompact LCP or P3AT mag. Retention is by friction and elastic pressure, quite good for slick, highly polished metal magazines and perfect for rougher plastic mags. The only magazines that do not work in this design are Smith & Wesson EZ9/380 designs with widely flared retention flaps that catch on the internal ribbing. Magazines may be placed with bullets facing either forward or backward.

Designed in America and originally produced in China, these carriers have been manufactured in the U.S. for over a year. I found the product to be very durable and extremely adaptable. Thus far, this author's girlfriend and he have used it for the GLOCK 17 and 23, Walther CCP and PPS, M1911, Grand Power X-CALIBUR and Stribog, KelTec® PMR30™ and CP33™, Fime Group's Rex Alpha and several other types of magazines. While the carrier with the mag removed shrinks to its minimal dimensions, it presents a wide enough mouth for one-handed replacing of the partial magazine. Being almost perfectly universal, it proved an excellent present selection for my gun-carrying friends. No matter what they wear, the Pitbull Tactical mag holder will fit. SADJ

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A mounted post-2000-manufactured GP-30.

GP-30 Russian Under-Barrel Grenade Launchers

Combining the Grenadier and the Rifleman

By Lynndon Schooler

In the jungles of Vietnam, U.S. Special Forces started to deploy under-barrel grenade launchers with the philosophy of combining grenadier and rifleman "seamlessly" into one weapon platform. Beginning development in 1964 with the GLAD project (Grenade Launcher Attachment Development) and the MACV-SOG (Military Assistance Command, Vietnam–Studies and Observation Group), operators were finally slung in 1967 with the XM148 grenade launchers under their XM177E2 carbines, the progenitors of the Colt Commando, M4 series and arguably, the AKS-74U or "Krinkov." Just a year later, the U.S. was fielding to great effect full-size M16s with the pump-open XM203, instantly recognizable by its distinct

cheese-grater-ventilated heat shield over the rifle's barrel. Soviet intelligence quickly took notice of this development cycle, likely long before the weapon ended up in the hands of U.S. operators.

Nonetheless, developing under-barrel grenade launchers is easier said than done, especially for a weapon platform that is inherently less modular than the M16. The Soviets recorded their first proposal in 1963 and began experimenting with grenade launcher attachments in 1966 with the TKB-048, the first under-barrel grenade launcher of the socialist state, yielding unsatisfactory results. The TKB-0121 followed in 1971–1972. After initial failures, the project came under the direction of V. N. Telesh, and subsequent Soviet grenade launchers to this day would be based on his ideas. Nonetheless, it took nearly a decade for the Soviet arms bureau to accept a working model, the GP-25 (*Grenatamyot Podstvolny 25*)—literally as a grenade launcher under-barrel 25, adopted formally in 1978. Once again, just over a decade later, the design was updated to the GP-30 by the Tula-based Central Design Research Bureau of Sports and Hunting Arms (TsKIB SOO). This time, the GP-30 had staying power just like its American counterpart, the XM203. All iterations of the GP series require mounting to full-sized AKs, precluding the AK-104/5, AKS-74U and the current shortened versions of the AK-200 series. The system also has a safety lock to only allow fire once secured to the "grenade launcher lug" below the rifle's gas block.

The GP-30 was a 30% lighter package than the GP-25, reduced in weight by over half a pound or .26kg. Designers removed the sighting pendulum and indirect fire capability from the launcher and relocated the sights to the right side. A simplified aiming system with a quadrant sight is marked out to 400m and allows for quick acquisition and impressive accuracy. The GP-30 has a 40mm launching tube, capable of firing 40x102mm VOG-25 fragmentation and 40x122mm VOG-25P bouncing/airburst charges. Like most Russian weapons, firing the GP-30 is soldier-proof. Unlike the prominent American design, the Soviet weapon is muzzle-loading with a spring catch to lock the grenade in place, no matter the orientation of the firearm. The safety selector is on the left side of the launcher; it is a simple 90-degree lever. The two-position safety markings are "**Or**" for "*ogon"* (fire) and "**пр**" for "*predokhranitel"* (safety).

This is the GP-30 sight, note the cross-bolt safety.

The firing pin actuates with each pull of the trigger like a double-action revolver. The recoil of the GP-30 is surprisingly mild, comparable to shooting a 12-gauge shotgun. However, due to the design of the AK, which allows for considerable flex, the GP series puts excessive stress on the host rifle. This limits the service life of the Kalashnikov, as each rifle is not to exceed 100 shots from the GP, because cracks typically begin to

Sighting and shooting are very seamlessly easy and highly accurate.

form behind the front trunnion.

Ammunition

The ammunition for the GP arms itself after flight for 10m to 40m. The charges have a self-destruct feature after 14 to 19 seconds, should the grenade fail to detonate after primary impact. The VOG grenades are high–low pressure ammunition and caseless in that the propellant and primer are contained in the base of the grenade. When fired, there is no shell to extract, as with U.S. designs. A new grenade is simply inserted, theoretically increasing the overall rate of fire of the system. Typical rate of fire is 5 to 6 rounds per minute with aimed fire, and up to 20 rounds per minute for un-aimed "area suppression."

Caution

Should the launcher need to be unloaded, there is a spring-loaded extractor push rod on the left side. Russian operators have noted that this simple design has a higher propensity for accidents and that caution is advised. Placing one's hands in front of a live grenade launcher tube should give one pause. While the GP series has some mechanical safeties in place to prevent firing of the grenade during the loading process, they have been known to fail. Originally, the launcher was provided with a flat sheet metal "Fork" to press the grenade in place. Those were quickly tossed away. To safely load the GP, use your middle finger and index finger to seat the grenade past the locking switch. Deviating from this by using your entire palm or all five fingers clutching the grenade may add sufficient force to cause an accidental discharge if the firing pin is frozen forward. While this is a rare event, it is not impossible. Newer versions of the GP, such as the GP-34 designed by Izhmash have improved safeties to avoid this. The newest version of the GP-30 model is the GP-30M, a further simplified and lighter launcher. The sight has been further simplified to a leaf sight.

The Soviet and now Russian-production under-barrel grenade launchers come with field maintenance equipment consisting of a cleaning kit, a carrying pouch with rubber butt pad attachment and an improved recoil assembly for the AK to prevent earlier model rifles from flinging their dust covers off when fired. The typical grenadier loadout includes 10 rounds. Currently, Kalashnikov Concern is developing a new grenade launcher for the AK-12 / -15.

Author Assessment

After extensive testing overseas, I can definitively say that the GP series is high-functioning. It can be fast when it needs to be and is simple enough to overcome the stress and uncertainty of the battlefield. It does not burden the operator with heavy weight or a long and cumbersome tube. As is tradition with all Russian weapons, it is robust and certain to be a standard feature in armed conflicts in the next decades. SADJ

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The Rogers Rail Light mounted to a Smith & Wesson M&P.

The Rogers Rail Light

The Little Light That CAN (Do Just About Anything)

By Seth R. Nadel

Flashlights—handheld or weapon-mounted—are flooding the market. Just like having a large box (actually several boxes) of holsters that either did not work or are just outdated, the author now has a box of flashlights that do not meet current (pun intended) needs. The first light my law enforcement agency issued was a two D-Cell, tinny, shiny aluminum light that could throw its puny beam almost the length of a car. Early on, the author decided that his life was worth the price of a good, bright light. From the first Kel-Light, the first strong aluminum tube, bright (for the times) flashlight, improvements changed to what was desired to light up the night.

Now living way out in the country with the nearest neighbor a quarter mile away, it gets dark out here—there are brilliant views of the stars, the Milky Way and the yearly meteor showers. By dark, it gets "can't see your hand at 3 inches in front of your face" dark, so handheld and weapon-mounted lights are not optional, they are necessary! Though this author no longer chases criminals, there are tripping hazards everywhere and coyotes, feral dogs and snakes (as well as some humans) that pose today's threats.

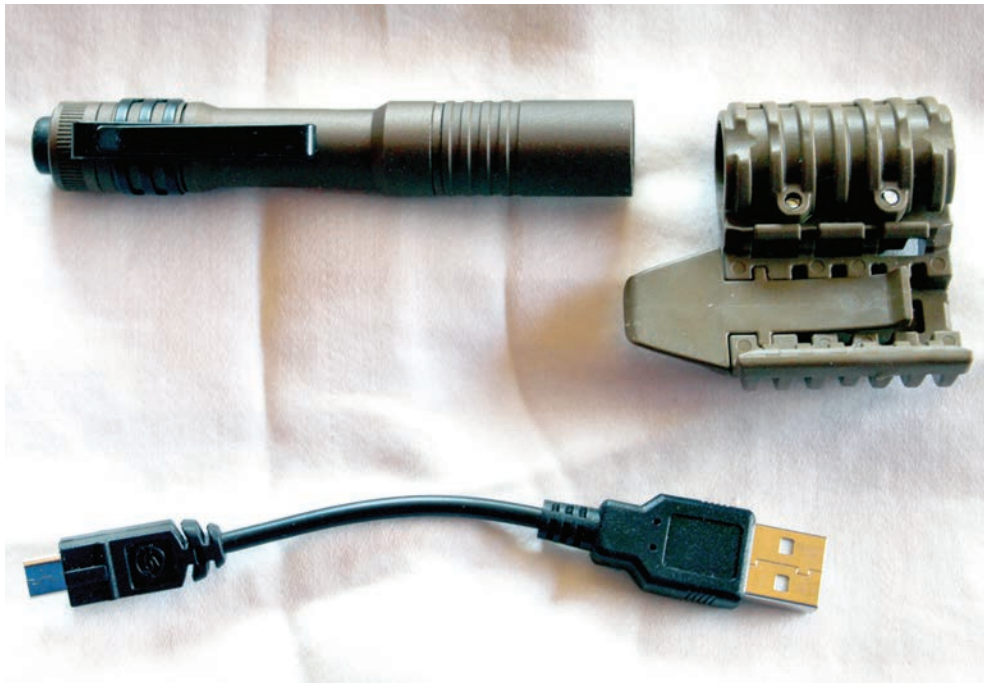
My first useable rechargeable light was the Streamlight SL-20®, which was

Snapping the light on from the side keeps your fingers clear.

a great upgrade. The other Customs Agents in my office were amazed that they could feel the heat from the light on their skin at close range and at the brightness and distance of the beam. But as the old cigarette ad stated, "[We've] come a long way baby!"

A New Streamlight

That SL-20 is 12 inches long, 1.5 inches in diameter and weighs almost 2 pounds. It was state of the art back in 1982 when I bought it. My new Streamlight is the MicroStream® USB, less than 4 inches long, 6/10ths of an inch in diameter and weighs next to nothing—2.2 ounces to be precise. It lasts longer (2 hours on high), throws a longer beam (100 yards) and charges off a USB outlet in 4 hours. Plus it sports an "S"-shaped clip, so it can be clipped on the edge of a pocket for every day carry or attached to the brim of a baseball cap when dodging rocks in the dark while carrying "stuff" in both hands.



The complete kit—light, attachment and charging cable.

Lighting up a danger zone with the Rogers Rail Light—all light from the RRL.

Enter Bill Rogers

Yes, Bill Rogers, the shooting instructor and holster designer (**rogershootingschool.com)**, also a former Federal Agent (FBI, not Treasury). Bill has designed holsters of all sorts and with lighter, smaller lights, he now has a way to make the MicroStream USB a pistol/rifle light! Utilizing a tiny, polymer, molded piece, he has expanded the usefulness of this tiny light beyond what you would expect, as the Rogers Rail Light (RRL). In his design, he also eliminates one of the potential negative outcomes of attaching a light to your handgun under stress.

The author is not a huge fan of lights on handguns, as all too often they get used as search tools, resulting in guns getting pointed at things that do NOT need to be shot! At the same time, once a threat is identified in the area, a light on your handgun or rifle is a great asset.

Most attachable lights must be slid onto the rail from the front. Lacking concealed carry holsters that would accept the gun with light attached, a different procedure is called for. Putting a hand in front of the muzzle of a loaded handgun during "administrative handling" is bad enough and requires your complete attention. In a stressful situation (and I have been in a few) with a full adrenaline dump, a hand in front of the muzzle is not a good idea. After 27 years in Law Enforcement and 6 years as a firefighter, I still have all my digits in full working order—and I intend to keep them that way!

The Rogers Rail Light clipped to a hat to avoid tripping at night.

Bill found a better way, keeping your precious fingers out of the way of potential flying lead objects. With

Using the light with the support-hand thumb.

his clever device, you can attach the light from the side, snapping it in place or removing it without blocking the muzzle. While it may not work on every gun, it works on a Smith & Wesson M&P perfectly. It fits with equal ease onto my AR—never use a handgun if you can access your rifle!

The mount can be adjusted so you can depress the tail switch with your support-hand thumb, and it is reversible, so lefties can use the light as well. It is deliberately set up so you only use the light momentarily when mounted to your gun. This is in keeping with defensive tactics, where you do not want to "flag" your position with the light on all the time. Press it, decide if shots are needed and fire, release and move. Move in the dark, shoot with the light. Remember, it is better to give than receive—gifts or bullets. For more mundane nightly "anti-trip duty," a hard press of the tail-cap switch turns the light on or off constant.

The MicroStream lets you know when it needs a recharge by dimming the beam. It recharges via the now ubiquitous USB cable, through a hidden port on the light that does not require removing the mount. From dead, it takes 4 hours to charge the battery. I use a portable battery to recharge mine, as my desk is "fully loaded" most of the time, and it reduces clutter in my workspace. (I have been accused of being "clutter-blind" by my bride.)

From the 1980s SL-20 to the 2020 MicroStream—what a difference!

Summary

The Rogers Rail Light has become part of my everyday carry, use-it-all-the-time gear. In fact, I use it every night and some days when gravity snatches some small part out of my hand and rolls it under a workbench. I sometimes forget I have it clipped to my pocket. Clipped to the brim of my hat, it has saved me from any number of rocks that have leapt into my path. It has become the perfect complement to my gun/holster/knife/ID setup—and may be just the ticket for yours. SADJ

Developing t

Ukrainian UAG-40 automatic grenade launcher.

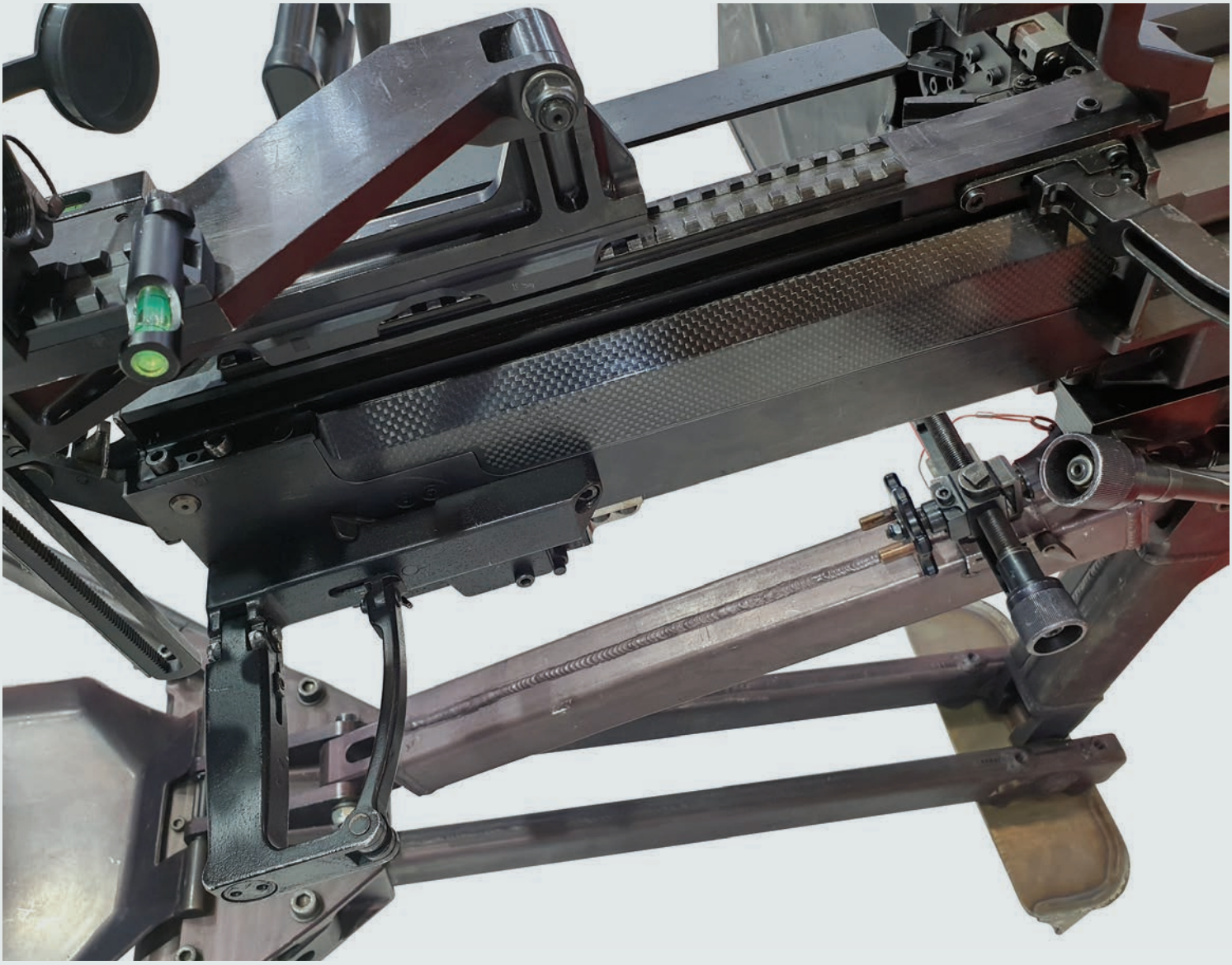
he UAG-40

Ukrainian Lightweight Automatic Grenade Launcher

Story and Photography by Kristóf Nagy

The automatic, belt-fed UAG-40 grenade launcher is one of the many domestic arms developments to come out of Ukraine in recent years. It was developed and is currently manufactured by *Kusnja na Rybalskomu*, a shipyard and major arms manufacturer in Kiev, located on the banks of the Dnieper River. Kusnja na Rybalskomu, known as *Leninska Kuznya* since 1924, changed its name in 2017 in accordance with new Ukrainian regulations which do not permit references from Soviet times in company names.

Design work on the system began in 2011 and was significantly accelerated by the conflict in eastern Ukraine, beginning in 2014. What makes the UAG-40 stand out from other, similar automatic grenade launchers chambered for the 40x53SRmm cartridge is its remarkably light weight, as well as a combination of interesting design features. It weighs just 18kg by itself, with a total mass of 40kg with a tripod and mounted ammunition box. By way of comparison, the U.S. MK19 Mod 3 weighs approximately 65kg with the MK64 Mod 7 gun cradle on the M3 tripod, *without* an ammunition box. This substantial reduction is achieved by the widespread use of lightweight materials including titanium (which accounts for 80% of the tripod, for example) and carbon fiber, which is used in parts of the receiver. In addition to the weight reduction, the manufacturer claims to



Lightweight components of the UAG-40, including visible titanium and carbon fiber.

have developed a weapon that is also superior in accuracy.

Function and Form

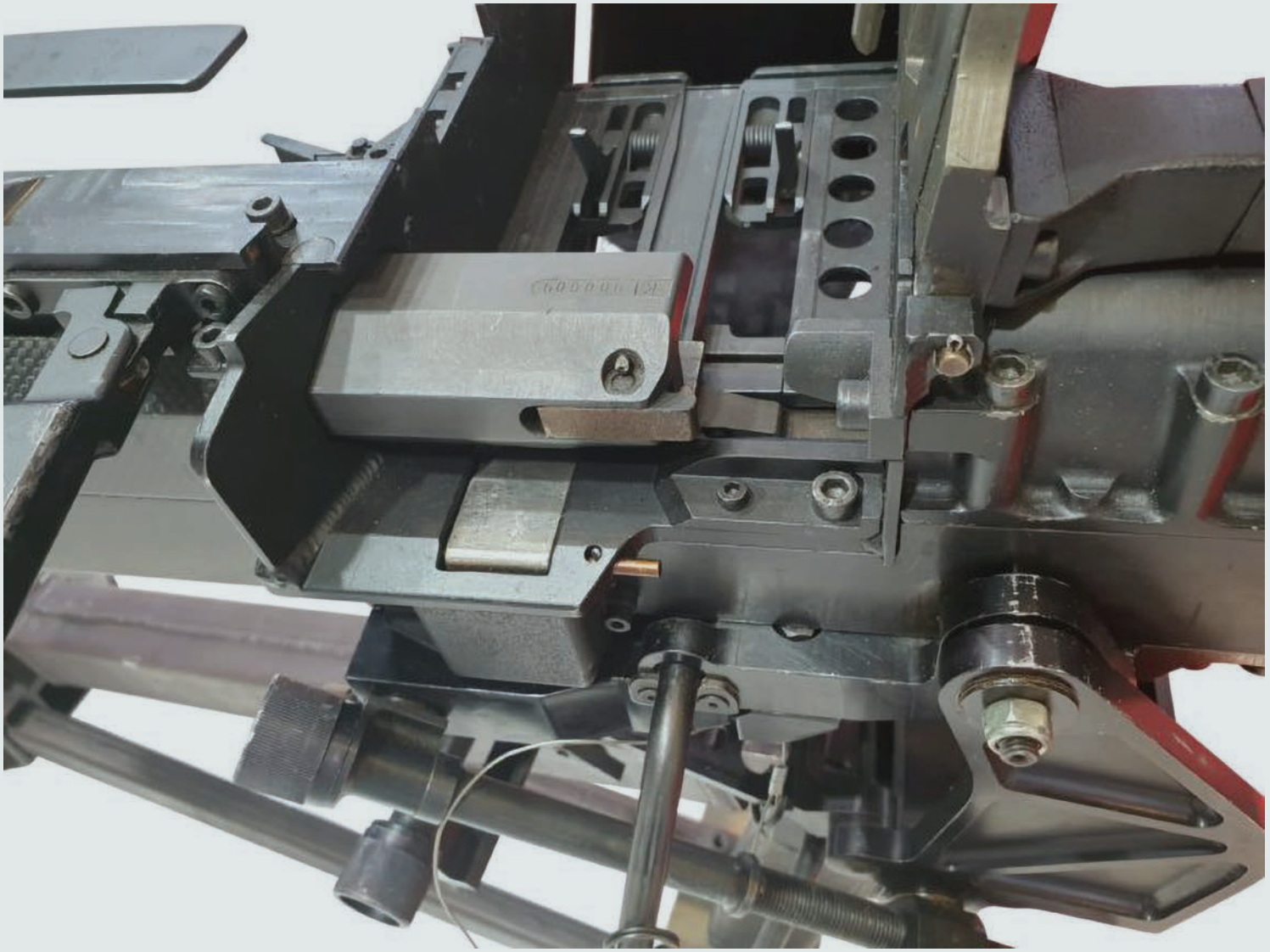
To investigate this claim we must more closely examine the function of the weapon and its internal components. Broadly speaking, to increase accuracy in this type of automatic weapon, a significant reduction in recoil is needed. One way to mitigate recoil within a gun is to increase the mass of the weapon or its mount. With the UAG-40 actively seeking to *reduce* the total system weight, some sort of recoil mitigation is a necessity.

To tackle this problem, the engineers at Kusnja na Rybalskomu utilized a variant of the blowback operating system that is known as "advanced primer ignition" (API). The API blowback operating system was developed by Reinhold Becker for his Type M2 20mm automatic cannon early in the first World War and was later adapted to famous designs such as the Rheinmetall-Borsig MK 108 30mm automatic cannon, when a lightweight solution with little recoil was needed, and muzzle velocity was not the primary focus. Other AGLs, such as U.S. MK19 series guns, have also used this operating system.

The essential concept underpinning the API blowback concept is that a cartridge is fired before the bolt is fully in battery and is still moving forward. A key benefit of this operating system is that the rearward impulse exerted by the expanding gasses generated by the functioning of a cartridge must first overcome the forward motion of the bolt, slowing and stopping it before propelling it to the rear of the receiver. One effect of this is that the bolt does not strike the breechface with as much force as it would in a conventional ("straight") blowback design, which can help with accuracy.

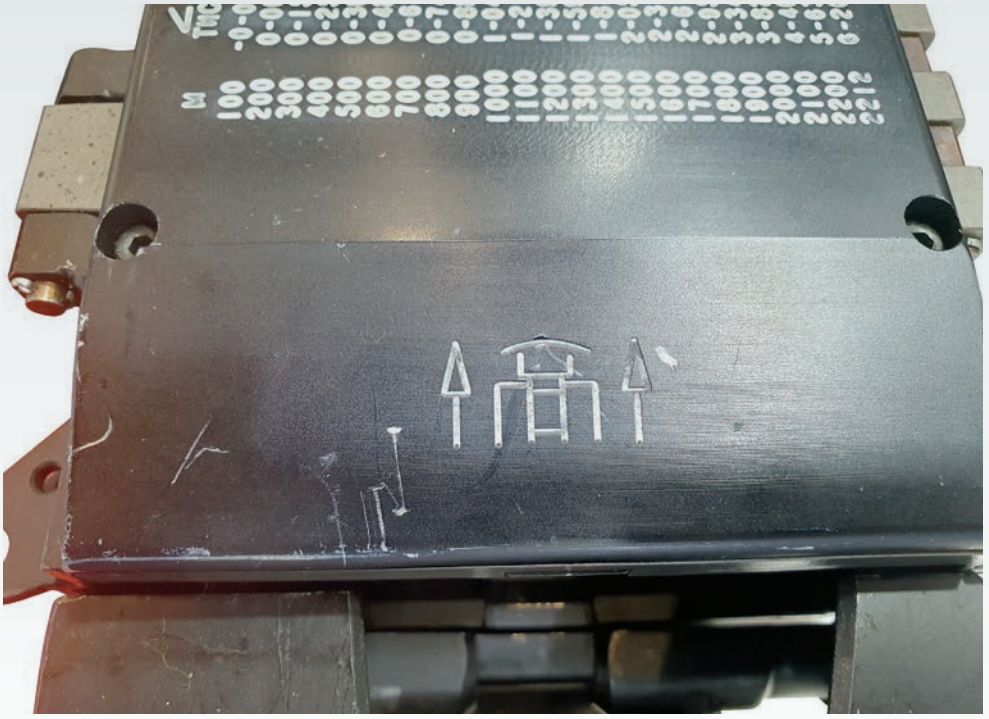
API blowback designs also allow for a lighter bolt—in the case of the UAG-40, a bolt of less than 5kg—and a lighter ("weaker") recoil spring that makes cocking the weapon easier. To ensure that the cartridge case is not ruptured on ignition, API blowback weapons often utilize a chamber that is significantly longer than the round itself. In the case of the UAG-40, the chamber is made of titanium to further reduce weight. Nevertheless, the coordination between bolt mass, ammunition impulse, spring tension and chamber length must be precise, which generally results in lower muzzle velocities. Additionally, the precise chamber length requirement means the ability to fire a range of ammunition is limited.

While the first two drawbacks are largely irrelevant for a grenade launcher firing the 40x53SRmm round, the limitation in ammunition variety



Feed tray of the UAG-40 automatic grenade launcher.

is not. This is particularly true when export customers might be expected to have a range of ammunition in their stockpiles. To ensure that the UAG-40 will accept a wide range of available rounds, the engineering team tested the ignition of rounds that were only partly chambered. After conducting some research, they claim that the thick, lower portion of the 40x53SRmm cartridge case—the smaller, high-pressure chamber in the "high-low pressure system" of the cartridge case design—withstands the pressures generated by firing even when not fully supported by the chamber. This apparently gives the system a relatively wide margin of error of some 3mm to 4mm within the chamber, which provides enough flexibility to accommodate the commonly available existing rounds in this caliber. Recoil reduction is also enhanced by a multi-chambered muzzle brake.



Markings on the UAG-40 automatic grenade launcher.

To increase accuracy, the barrel of

UAG-40 automatic grenade launcher disassembled into combat loads (*not to scale*).

the gun features an increasing number of rifling grooves as you move toward the muzzle. This is not to be mistaken with "progressive rifling," in which a gradually increasing pitch imparts an increasingly faster spin to the projectile as it progresses towards the muzzle. In the UAG-40, the barrel is divided into three rifled segments. The barrel segment behind the chamber features 12 rifling grooves, the midsection 18 and the last third of the barrel 24. According to the manufacturer, they are also manufacturing a version with 36 grooves in the last segment before the muzzle. Kusnja na Rybalskomu claims that this will enable unmatched accuracy in such a weapon, up to a distance of 1,500m, while area targets can be hit (depending on the ammunition) to a distance of up to 2,200m.

According to the manufacturer, the overall service life of the system is approximately 15,000 rounds. The barrel must be changed after some 6,000 rounds, while the recoil spring will last for about 10,000 rounds.

The UAG-40 has its own foldable iron sights and is fitted with a Picatinny rail at the rear of the receiver in order to accommodate a wide range of optical sights and night vison devices. The belted ammunition is fed from an ammunition box that is fixed to the left-hand side of the receiver, and the whole system can be easily broken down into two man-packable loads. These fit into two backpacks, with neither load weighing more than 22kg (excluding ammunition). In addition to the standard lightweight tripod mounting, the weapon can also be mounted on a multitude of vehicles and is also part of the armament of the Kentavr fast assault craft and an option for the Gyurza-M armored artillery boat, both produced by the same manufacturer as the gun.

Other Designs

In addition to the UAG-40, Kusnja na Rybalskomu has also designed and is beginning to manufacture limited quantities of two different 40x53SRmm cartridges. To improve the reliability of the ammunition, a proprietary fuze has been developed. This fuze has also been installed in domestically produced VOG-25 grenades. Being based in the heart of Kiev, the final assembly including the processing of explosives is undertaken for safety reasons by a company named Impulse in the north-eastern Ukrainian city of Shostka.

The Ukrainian military has acquired a total of 500 systems, beginning in 2016. Some sales to customers abroad have also been documented. The manufacturer has focused on marketing the product to potential international buyers, with a clear focus on countries in the Middle East. With sufficient financial and technological background to support further development, the UAG-40 is a design that demonstrates potential for an evolution into a successful product and should therefore be closely monitored in the upcoming years. SADJ

TECHNICAL SPECIFICATIONS

CALIBER: 40x53SRmm
LENGTH: 960mm
HEIGHT: 210mm
HEIGHT WITH TRIPOD: 763mm
WIDTH: 408mm
WIDTH WITH TRIPOD: 1,070mm
BARREL LENGTH: 400mm
WEIGHT EMPTY: 18kg
WEIGHT WITH TRIPOD AND AMMUNITION BOX: 40kg
RATE OF FIRE: 370-400 rnds/min
RANGE: 2,200m (varies with ammunition)
V0: 240 m/s (varies with ammunition)

SOURCES

Chinn, George M. 1955. *The Machine Gun, Volume IV.* Washington, D.C.: U.S. Navy.

Interviews with manufacturer, Istanbul, 2 May 2019.

Kusnja na Rybalskomu catalogue.

Confidential sources.

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Defense Industry Reform

THE ARMS AND SECURITY INTERNATIONAL EXHIBITION has already become a notable event in the defense industry and is gaining a leading position among similar events in Eastern Europe.

In recent years, the security and defense sector of Ukraine has gained invaluable experience that should be taken into account by all the countries in Europe and the world. Ukraine has confidently resumed its presence in the international defense market, and, along with ensuring its own needs, it has established military–technical cooperation with a number of countries on the basis of collaboration, joint activities and partnership.

Today, defense industry reform is a hot topic, as it should lay the foundations for further development of high-tech production facilities.

In general, the main priorities in the defense industry remain unchanged, namely: revival and development of infrastructure facilities; purchase, modernization and repair of weapon systems and military equipment; and acquisition of the necessary capabilities that meet the criteria for NATO membership. Within the 3 following years, it is planned to create an efficient Maritime Guard capable of effectively protecting maritime borders and adequately countering challenges of the transnational and illegal nature.

The exhibition is a rare opportunity to communicate with manufacturers of new types of weapons that were born and developed in modern combat conditions. In addition, this is an opportunity to meet and communicate with technical and field officers of the Armed Forces of Ukraine and NSU. These officers are an important part of the procurement process as they provide both initial reports regarding products' and companies' assessments on the basis of which decisions are made.

The special feature of the exhibition is its section dedicated to hunting, shooting sports, self-defense, cold steel and outdoor products. This part of the exhibition is touted as the "shopping center for real men" by all attendees.

We invite all companies and organizations to attend the Arms and Security XVII Exhibition in order to develop cooperation in the field of both export and import of weapon systems and aerospace products, design of new technologies, integration of these technologies into end products, as well as joint investments into new products. SADJ

ARMS AND SECURITY 2021

XVII International Exhibition
April 27–30, 2021

2019 Key Figures

- 60+ countries
- 25,000+ trade visitors
- 34,000 square meters of space
- 50+ units of military and aviation equipment and vehicles
- 300+ defense and aviation industry enterprises

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Boutique Beretta 9

Making AIWB Concealed Carry Comfortable

Story & Photography by Alton P. Chiu

The Beretta 92 series enjoyed prominence in the 1980s and 1990s, featured in films like "Die Hard" and "Lethal Weapon." Despite the pivot to striker-fired pistols, the Beretta factory has continually updated the series while custom shops such as Langdon Tactical Technology and Wilson Combat produced bespoke versions. Holster manufacturers are also continuing to marry modern preferences to the venerable Italian pistol. This article examines two such holsters for the Beretta 92: an AIWB (appendix inside waistband) conceal carry holster from Tier 1 Concealed (**tier1concealed.com**) (T1C) and a duty holster with retention hood from T5 Custom Kydex (**t5customkydex.com**).

T1C AWIB

The AIWB carry position, where the pistol is carried just off the 12 o'clock position with the muzzle between the thigh and the wedding vegetable, has become popular in the past decade due to its speed and ease of concealment. Strong-side IWB holsters do not work well in the appendix position, as inevitably they have edges that dig into body parts. Also, a stand-alone holster rotates as the user moves to make for inconsistent draws. Combining with a magazine caddy adds stability. These are the raison d'être for having a dedicated and well-designed holster for AIWB carry. The author purchased an AXIS SLIM, examined here.

AIWB holster option.

Bread-and-Butter Models

AXIS and AGIS are the two popular AIWB holsters, with regular and Elite sub-models. The AXIS attaches the magazine caddy to the holster with a shock cord which allows more flexibility to conform to body movement. AGIS uses button snaps instead of shock cord, so one can easily separate the two and use the holster for strong-side carry. These two holsters have regular (AXIS SLIM, AGIS) and Elite (AXIS ELITE, AGIS ELITE) sub-models. Elite places the magazine further from the centreline with the magazine retention screw closer to the centerline. A ridge is formed onto the magazine caddy such that the belt pulls it taut against

92 Holster Options

AIWB holster option.

the body. In contrast, the "regular" sub-models place the magazine close to the centreline with the retention screw at the outside. Furthermore, they have more relief around the thigh area with rounder corners. They also have a Kydex "wing" that extends further out to the edge, so the claw (used by the belt to tuck the pistol handle against the body) does not need to be as long.

Options

The holsters support a plethora of weapon lights and pistol models, although not every combination is supported. For example, a holster for a GLOCK 19 can be paired with lights, but the Beretta M9A3 currently has no such option. An optics cut can also be ordered where the Kydex is cut away instead of moulding around the red dot sight. T1C's website notes that those using the Trijicon SRO should choose the "rear sight in front of optic" option.

This author specified a threaded barrel when ordering his AXIS SLIM and can verify that his Gemtech® threaded barrel that was installed on the Beretta M9A1 and Langdon Tactical Elite LTT both fit the holster well, with no metal protruding below the Kydex. The shock cord as well as front and rear Kydex colours can be individually specified to add some flair. Lastly, the magazine caddy can be specified as "bullet front" or "bullet rear" to fit individual preferences when reloading. One can also specify the spare magazine capacity; T1C will place extended magazines lower so as to offer better

Small wedge for cushioning user's thigh against the Kydex edge.

concealment. The author chose the "+2" option, and he could still easily access OEM standard 15-round magazines for reload while extended 20-round magazines sit high enough that the base plate prints through clothing.

The author recommends taking advantage of the "wedge sizing pack" option. The wedge is a wedge-shaped foam that can be affixed to any part of the holster with the pack containing four sizes for different body types. For better concealment, it can be placed on the slide area to push the top of the holster into one's belly; although the author did not find that necessary. Instead, he placed it near the trigger guard to better cushion the thigh against the Kydex when seated. Note that these wedges lose shape and wear with use and should be replaced regularly.

Lastly, one can specify the belt clip as either the "Standard 5-hole" for belt carry, or the UltiClip3+ which clamps onto the pants for a beltless carry. The author ordered the "5-hole" belt clip, which when combined with the four holes drilled into the Kydex, offers multiple adjustments for height and cant. Positioning the clips close to the top made the holster ride deeper for concealment at the cost of access. Unequal height of the clips can minutely change cant. The author positioned his clips such that the holster rides high with a slight cant away from his thigh (towards the bodkin) for a faster draw.

In Use

The author found his AXIS SLIM exceptionally comfortable, even when hiking. Despite the ups and downs of rocky terrain, the holster moved with the belt line and always returned to a consistent and comfortable position. When entering vehicles, the author found he must tug up his holster to allow him to bend at the waist. This was necessary for small vehicles with seats adjusted upright "cockpit style" (e.g., Honda S2000), but less so for trucks with spacious seating (e.g., Toyota Tundra). Overall, the author found this an appreciable improvement over a strong-side holster for comfort when driving and when hiking with a strap-only backpack.

T5 Custom Level 2 Duty

The author wanted an overt holster to hold a Beretta M9A1 with a SureFire® XVL2, but at the time of writing, there are no off-the-shelf options. T5 Custom was happy to make a Full

Thumb rests atop a high sweat guard for draw.

Custom Level 2 Duty Holster using the author's XVL2 for mould. Pictures on T5 Custom's website also show many non-standard configurations.

Options

T5 can accommodate red dot sights when users check the option "RMR Cut" and explains their setup in the provided textbox. Note that this option merely cuts away Kydex instead of moulding it over the optic, so the view window is left open to the elements.

T5 Custom offers three different belt attachment "ecosystems:" Safariland®, G-Code® and Blade-Tech®. With the Safariland system, T5 offers a UBL Mid-Ride belt mount with a QLS quick-attach system or the QLS only. The first option allows one to mount the holster directly to the belt slide mount. The second option has the holster mounting to a QLS fork while the QLS receiver attaches to the belt slide mount; this allows for a quick swap or detach of the holster. The author chose the second option so as to utilize his True North Concepts Modular Holster Adapter which attaches to his belt via MOLLE. Similarly, one can configure his holster for the G-Code system by having just the hanger on the holster, adding on a paddle mount, a MOLLE adapter or even a thigh rig that includes a stabilizing strap. Lastly, the Blade-Tech configuration offers a Duty Drop and Offset mount (abbreviated as DD/OS on the T5 Custom website) in Gen1, Gen2 or Gen2 with thigh strap. Since most users have already bought into a holster "ecosystem," this flexibility allows them to use existing hardware.

Three different retention hoods are also offered: Safariland SLS, Blade-Tech WRS and Paladin Systems Level 3. To disengage the Safariland SLS, the user pushes down on the hood with thumb while rotating it forward. According to the owner, T5 Custom sources the retention hood from used or surplus holsters in good condition since Safariland does not sell just the hood. The author opted for this, and his example looked barely used. T5 offers the option to add an SLS Sentry for Level 3 retention. Blade-Tech WRS's requires the user to push a lever to the side which allows the hood to spring forward. The author could not find much information about the Paladin Systems Level 3 to indicate a mode of operation. These options allow users to maintain their manual of arms if they were already familiar with one system.

Left: The Safariland SLS retention hood and QLS fork. *Right*: The QLS receiver on a True North Concepts Modular Holster Adapter.

In Use

Retention was achieved by folding the Kydex behind the weapon light, and the author found the fold overly aggressive with too much retention for a smooth draw. This was solved by using a heat gun to soften the Kydex and reshaping it. Even then, the author removed the middle two tensioning screws. The bottom two screws give some tension when the pistol is fully seated so that it passes the basic retention test of not falling out when turned upside-down. The top screw provides some more resistance to help prevent it from falling out when shaken upside-down. The slight drop and offset mount also complicate retention adjustment, where too much results in the user twisting the holster with the bottom canting outwards, rendering retention a personal and difficult adjustment to make at manufacture time.

There were also some minor details that the author addressed. The screws mounting the SLS hood to the holster shell were slightly loose as shipped but were easily fixed. The hood initially did not rotate smoothly and emitted some metal-on-metal rubbing noises; a quick squirt of oil remedied this. Lastly, the edges of the Kydex were slightly sharp and were addressed with sandpaper. After these initial adjustments, the holster worked admirably with no failures. Combined with the True North Concepts Modular Holster Adapter, it allowed one to easily draw his pistol and clear any chest-borne equipment. The author used this during a 6-day horseback pack trip with an average of 4 riding hours per day. The author neglected to apply thread locker to his screws and found some loose after the first day; determined application of a screwdriver prevented further problems and the thread locker was applied immediately upon return to civilization. The holster displayed no other troubles and still presented a small draw despite the trail dust.

Conclusions

The Beretta 92 series remains a popular pistol. Boutique holster makers like Tier 1 Concealed offer a purpose-built appendix holster that is comfortable when seated in a vehicle or hiking the great outdoors. T5 Custom answered the author's specific needs. After some initial adjustments, the holsters provided a reliable home for the venerable Beretta 92, mounting a newly released SureFire XVL2. The next time ***SADJ*** readers need a new holster, please peruse these manufacturers' offerings. SADJ

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What Target Is

Right for You?

Training Goals and Methods

Story and Photography by Oleg Volk

Steel target paint works equally well for making highly visible targets for competition and more subtle targets for a long-range self-challenge.

Selection of training methods and targets depends primarily on the goal of the exercise. Are you trying to diagnose a problem, test or configure equipment, improve skill level or compete with another person? A purposeful selection of the approach leads to efficiency.

The simplest example is the zeroing target designed to establish or confirm the setting of the sights. It has to be clear, high in contrast and contain data for adjustments. The point of impact may not be the same as the point of aim: for a 30m point-blank zeroing target for iron sights shot at 25 yards, the point of impact should be slightly low. That also keeps the aiming graphic from being obliterated by bullet holes. When zeroing scopes, the simplest way to find out the real drop at various ranges would be to obtain a 100- or 200- (for magnum calibers) yard zero, then shoot at longer distances. Even if much longer ranges aren't available, comparing the 100-, 200- and 300-yard progression to the ballistic charts will show if the values for 400 or 500 are realistic.

Diagnostic targets come in two different flavors. Testing equipment, such as load accuracy, still requires a clear and consistent point of aim. While zeroing targets may be used for this, specialized designs can show if aiming at a rabbit's body at the mid-trajectory apex would produce a head hit, or if a specific buckshot load still stays inside the thorax at 30 yards. The simplest diagnostic for testing technique, especially with unsupported shooting, is just a blank sheet of paper. Issues with

Shooting instructor and competitive shooter Dani Nickens stands next to a Texas Star (by Challenge Targets). Clearing the plates isn't that hard, but doing so quickly is quite difficult.

Kickboxing instructor Michelle DiCianni with a realistic 3D target designed by shooting instructor Tatiana Whitlock.

trigger control and flinching become very obvious when there are no details to distract from the front sight focus.

Low-contrast targets, from the official-issue Swiss camouflage silhouettes to the simple brown grocery bags weighted down with soot and set partly obscured behind grass, are great for diagnosing the resolution of optics and the suitability of iron sights. Since nobody wears red uniforms anymore, it pays to find out in advance if your choice of iron, red dot or scope even resolves the likely foe at a particular distance.

Animated targets are skill-builders. The genius Texas Star is easy to handle by waiting for the momentary pauses in the spin but harder to shoot in motion. At that, it's a high-visibility target that helps get hits. Paint it a break-up camouflage pattern and put a cardboard screen covering a part it, and you get a more realistic trainer for the urban environment where foes pop up briefly in windows. Make one of the plates a no-shoot, and it gets even more exciting to clear under a time limit.

A spring-loaded reactive popper (by Shoot Steel) gives instant visual and audible feedback.

The Exercise

Fighting is, fundamentally, about solving problems. A person under attack must prioritize several factors and act almost instantly. Exercises that task the trainee with multiple problems are more true to life than just hitting the bullseye. For example, having numbered targets and a legend "Five + 2" means target number seven should be hit. The command, "Not blue!" means all other targets should be engaged. What if the command is, "All red," and one of the targets is blue with the word *red* on it? Shoot or not, perhaps seeking cover and retreating is in order to get away from an ambiguous and dangerous situation. Shooting is simple; winning a fight takes more thought. Clarity of the course of fire is vital for formal competitions, but "fog of war" is typical of defensive situations and should be included in the training routines—which, by the way, should be anything but routine from day to day!

Does your exercise require feedback? If yes, high-visibility, multi-layered targets show one's hits well. Outdoors, a plastic jug suspended from a tree limb moves in response to hits. Movement, especially with a heavily asymmet-

Bank robbery! Airsoft shooting exercise (note the protective gear) from a R. Steven Rogers' Pistolcraft training course.

ric target, is important to train how to split attention between the front sight and the actively evolving foe. If no feedback on hits is needed, which is reasonable for learning to deliver rapid hits prior to evaluation, a brown grocery paper bag or a dark, low-contrast printed target would work. Bullet holes are seldom visible on clothing—real life isn't a Hollywood movie with squibs. A shipping cardboard box with black print on it is perfect in that respect, also having the advantage of being a three-dimensional form instead of a two-dimensional shape.

Should your exercise use a spotter? Absolutely! A competent observer can notice details that escape the trainee during the presentation and firing sequence and can provide detailed feedback on hits. Getting additional information is vital during all forms of practice other than self-diagnostic runs. For example, an observer can note if a shooter with a rifle zeroed 4 inches high is consistently producing low left hits, drawing attention to technique, or of hits are random and look keyholed through a spotting scope, suggesting an equipment issue. Ideally, the shooter and the observer should trade off at intervals, giving each a chance to see the process from both sides.

In general, graduated feedback targets, such as the classic IPSC silhouette, work best for building specific skills and enabling diagnosis of the near-misses. The pass–fail targets, like falling or fixed steel, work better for time-dependent skills. Designs that rank hits encourage marksmanship perfectionism at the expense of speed. Since range time and ammunition are usually in short supply, mixing up the two in the same exercise helps: Using large and small plates or paper targets in the same drill requires different emphasis on accuracy versus speed.

Birchwood Casey Dirty Bird splatter target torn up from 12 yards with a Guncrafter .50 GI™ Long Slide.

Since defensive training presupposes human opponents, it's well worth

HD Targets offers a wide variety of diagnostic paper targets with enhanced hit visibility.

working with anatomically correct targets. Faint anatomical details printed over more prominent silhouettes are a good start; three-dimensional targets that project correctly from different angles are even better. After all, the ideal solution isn't a bunch of peripheral hits all over a shape, rather specifically targeted hits into specific organs inside a volume.

Airsoft Can Help

Since movement and cover are seldom available at public ranges, air guns and airsoft come to the rescue! An airsoft shooting course for adjusting to movement and use of cover can be safely made indoors or in a back yard. A downrange video camera behind a piece of LEXAN™ would show the foe's viewpoint for debriefing. Even easier, a pistol-shaped, infrared, remote thermometer with a laser costing under $20 is a safe stand-in for a weapon. Slightly more expensive, a laser-equipped, blue, plastic handgun is more realistic and fits in a holster. Both permit an easy way to check angles, interaction with cover and even an approximation of force-on-force training with debriefing, relying on video review. One of the plusses to scenario playing is getting used to scanning for the initially unseen. It's no good to engage a known threat and miss its confederate behind your back.

Use Your Mind

Learning to shoot can be expensive due to the number of repetitions involved in forming a physical skill. Learning to fight, counter-intuitively, can be a less expensive proposition in terms of consumables. To speak in analogies, your mind is the "General," while your hands are the "line troops." Use your mind to conduct war games to avoid stupor when actually confronted with a bad situation. Devise range and home training to reflect the wide variety of threats existing in the real world. SADJ

LaserLyte training revolver has no recoil, helps shooters learn trigger control without using up valuable ammunition. Large zeroing target from GunFun is also useful for diagnostic drills.

At the beginning of the test phase, metal balls were used as a filling.

The SM-70 Automatic Firing Device of the Former Inner German Border

The Horrors of Post-WWII

The East German side of the inner German border was dominated by a complex system of fortifications and security zones to protect the country against the Western aggressors. In truth, however, it was to prevent its own population from escaping to the West, which was done by all means.

By Michael Heidler

The border guards referred to the side of the border zone facing the German Democratic Republic (GDR) as the *freundwärts* (friendward) side and the side facing West Germany as the *feindwärts* (enemyward) side. *Republikflucht* (flight from the Republic) became a crime in 1957, punishable by heavy fines and many years of imprisonment. From 1961 on, unauthorized crossers of the border risked being shot by East German guards according to their order to track down, arrest or annihilate violators. That same year, the GDR Minister of National Defense General Heinz Hoffmann gave a speech that was captured on film and said that "Whoever does not respect our boundaries will feel the bullet."

On September 14, 1961, General Hoffmann met with the commander-in-chief of the Soviet Armed Forces in Germany, Marshal Iwan Konev (Konew). The Marshal had concrete plans for the expansion of the border to the Federal Republic and West Berlin. Among other things, he called for wire barriers, minefields, signal devices, observation towers and control and patrol roads. Minefields, in particular, had a very deterring effect; when stepping on the mine, refugees sometimes lost limbs, and many people died by bleeding to death or suffered other serious damage. However, the advantages for border security were offset by some disadvantages. Not only did the mines hit refugees, border guards were also among the victims. Rainfall washed the mines away, and the mine plans no longer corresponded to reality. In addition, it was not unusual for the mines to be triggered by game running through the minefields.

General Heinz Hoffmann was GDR Minister of National Defense and a strong proponent of the firing order.

At the beginning of 1965, the GDR Ministry of Defense placed a development assignment with the VEB Chemiewerk Kapen armaments factory to design a tripwire-activated, self-firing system, initially referred to as an anti-personnel fragmentation mine. This factory had already been used as

One of the few surviving SM-70s. The trip wire is missing. Only the three wires serving as seats for birds are in place.

an ammunition factory from 1936 on; however, the engineers were unable to comply with the ministry's specifications. In August 1968, the first contact with the Military Technical Institute VUSTE of Czechoslovakia took place. On February 23, 1967, Czechoslovakia and the GDR completed a contract for the development and testing of a self-firing system and the delivery of 100 prototypes. From 1969, the devices, now called SM-70 after the year of planned commissioning, were manufactured at the VEB Chemiewerk Kapen. The electrical components for the entire plant were supplied by VEB Elektroapparatebau Bannewitz.

The East German government prevented its own population from escaping to the West with all means necessary—including despicable self-firing devices.

The Mine Barrier System

The test set-up was carried out from winter 1970–1971 on the inner German border in sectors Salzwedel–Lüchow (3-mile area) and Arendsee–Prezelle (6-mile area). Completion of the test set-up was scheduled for January 1, 1971, but was delayed until mid-April 1971 due to weather conditions and the lack of material arriving in time. The cost and complexity of the set-up were considered to be high. Therefore, the construction was to be simplified by plug connections and more precise markings.

Although the mine showed its effectiveness when triggered by pigs driven to the test set-up, there were also accidental activations caused by lightning strikes due to insufficient insulation. At the beginning of the test phase metal balls were used as a filling. Later these were replaced by sharp-edged metal splinters because they caused heavier injuries and were therefore more effective. The first partial report ("VVS No. G/079675") of the test from August 17, 1971, came to a positive conclusion: "The splinter effect on deer, wild boar

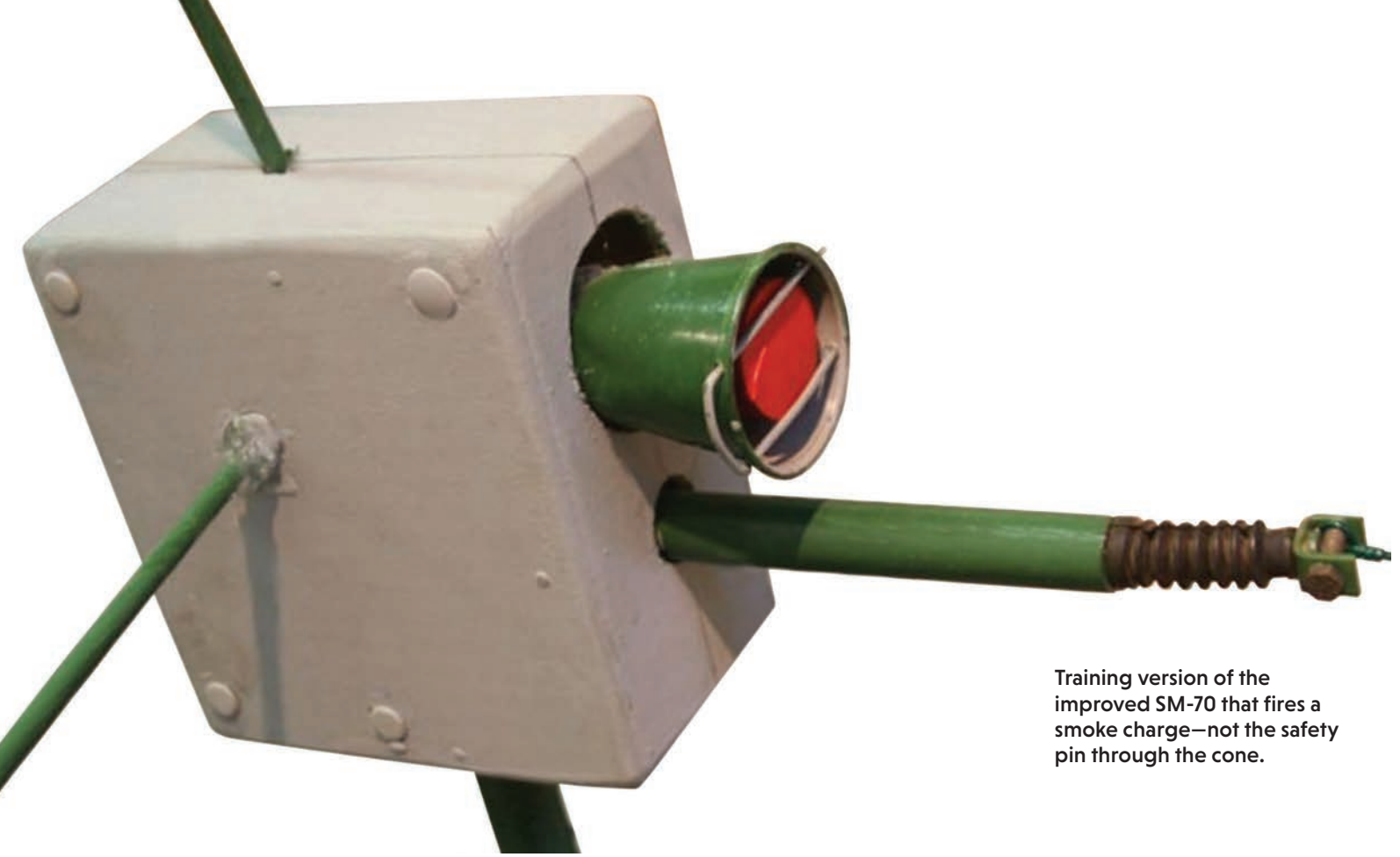
Later the balls were replaced by sharp-edged metal splinters to cause more serious injuries. With the more powerful SM-70/M again ball bearings were used.

and feathered game allows the safe conclusion that border violators hit by SM-70 suffer fatal injuries or injuries so severe that they are no longer able to overcome the barrier fence." By the way, the designation "SM-70" only refers to the mine launching device. The whole system was officially called the "Mine Barrier System MS 501."

Some 1.3 million anti-personnel mines of various Soviet-made types had been laid along approximately half of the border's length. In addition, the outer climb-resistant, prefabricated, steel mesh fence was continuously booby-trapped with around 60,000 SM-70s that were mounted to the concrete posts of the fence. They were aimed parallel with the fence line. Contrary to popular opinion, the SM-70 was never used at the Berlin Wall.

The SM-70 consisted of the cone-shaped mine and a trigger mechanism located in a protective tube. The cone was made of aluminium and contained in its rear part the cable to the trigger mechanism, the electric detonator and the booster charge of 0.32 ounce of nitropenta. The main chamber of the cone was filled with explosives and fragments and was closed with a thin cover.

The mines were mounted offset at three different heights on the posts



Training version of the improved SM-70 that fires a smoke charge—not the safety pin through the cone.

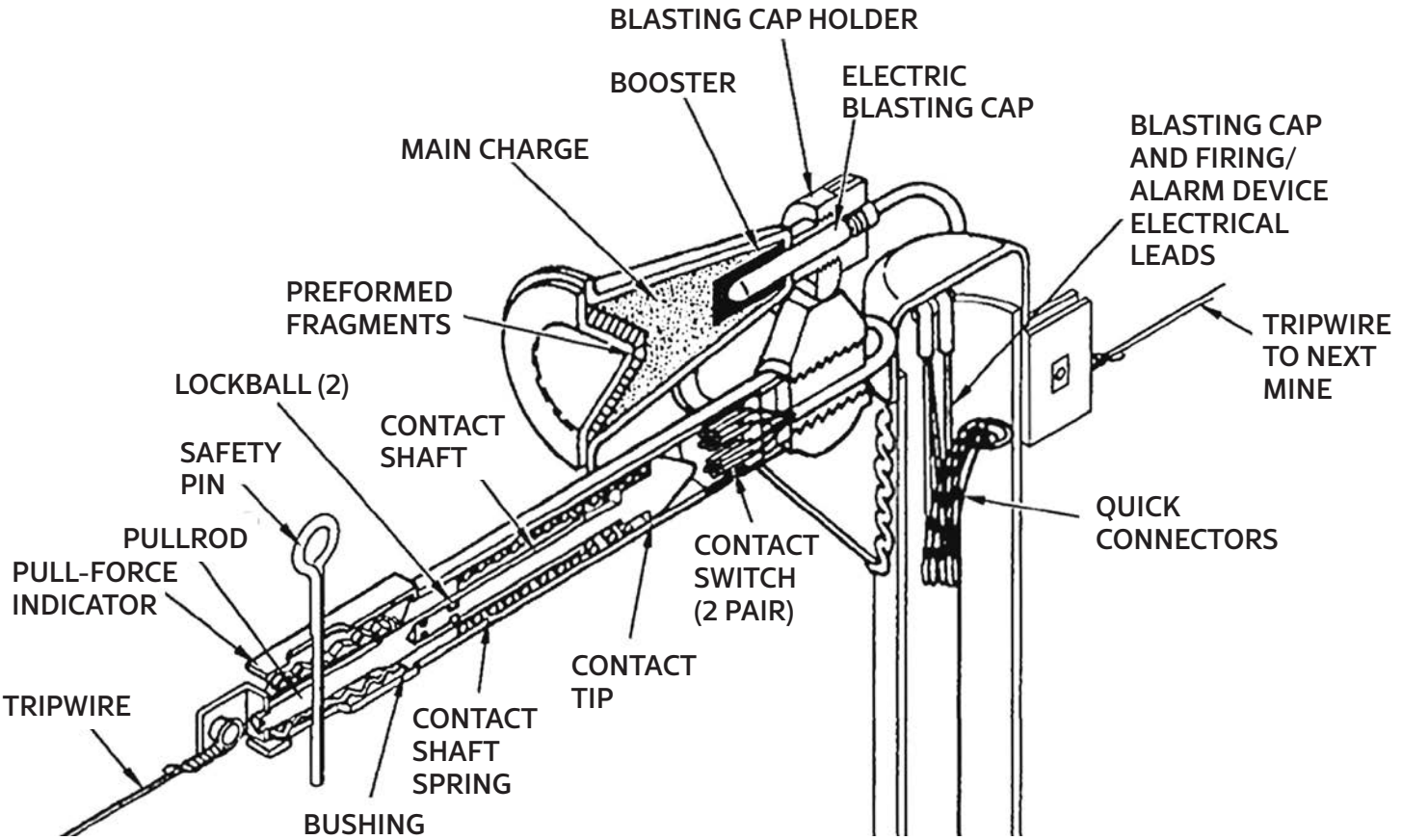
of the border fence on the GDR side. The distance to the next mine at the same height was 98 feet. Between the mines, one trip wire and two bird protection wires were stretched. The bird protection wires were intended to serve as seats for birds and thus keep them away from the trip wire. The trip wire was tensioned by means of a spring. If the wire was tensioned or released by pressing down or cutting it, the mechanical release mechanism moved forward and closed two electrical contacts. One contact was connected to the detonator in the cone and ignited it electrically. The second contact activated an alarm signal at the nearest guard house.

The SM-70 fired 80 sharp-edged steel splinters by means of a charge of 3.9 ounces of TNT explosives with a range of 395 feet and a lateral spread of 49 feet. The mine was lethal in the 35-foot range. A slightly changed version, the SM-70/M fragmentation mine of the improved 701 Mine Barrier System, was filled with 3.45 ounces of TNT / hexogen (45% / 55%) and fired 20 ball bearings of 0.31 inch in diameter with a range of 920 feet and a lateral dispersion of 85 feet. This mine was lethal in the 60- to 100-feet range. It was also insensitive to electromagnetic interference from lightning or strong transmitters.

Boundary post of the German Democratic Republic (GDR). The wreath of corn symbolizes the peasant class, the hammer the working class and the sickle the academics.

From 1976, the mines were protected by a grey plastic housing. This was not only a cover against weather conditions, but also a measure against sabotage and theft. In order to expose the propaganda of the GDR, which denied the use of self-firing devices along the inner German border, the West German activist Michael Gartenschläger, among others, dismantled an SM-70 on March 30, 1976, which he sold to the German magazine "Der Spiegel." He dismantled another SM-70 on April 23, 1976, and sold it to a non-profit association. On the night of May 1, 1976, Gartenschläger wanted to steal a third SM-70 around the same place, but the border guards were alerted and already waiting for him. After entering GDR territory he was detected, and he opened fire with a pistol. The guards returned fire and wounded him mortally.

According to the information available so far, nine cases have been proven in which GDR citizens died by SM-70 devices during an attempted escape. On the evening of November 14, 1972, Johannes-Leo Hoffmann activated two self-firing devices when crossing the second barrier fence, which had been installed there only a few days earlier. He suffered severe

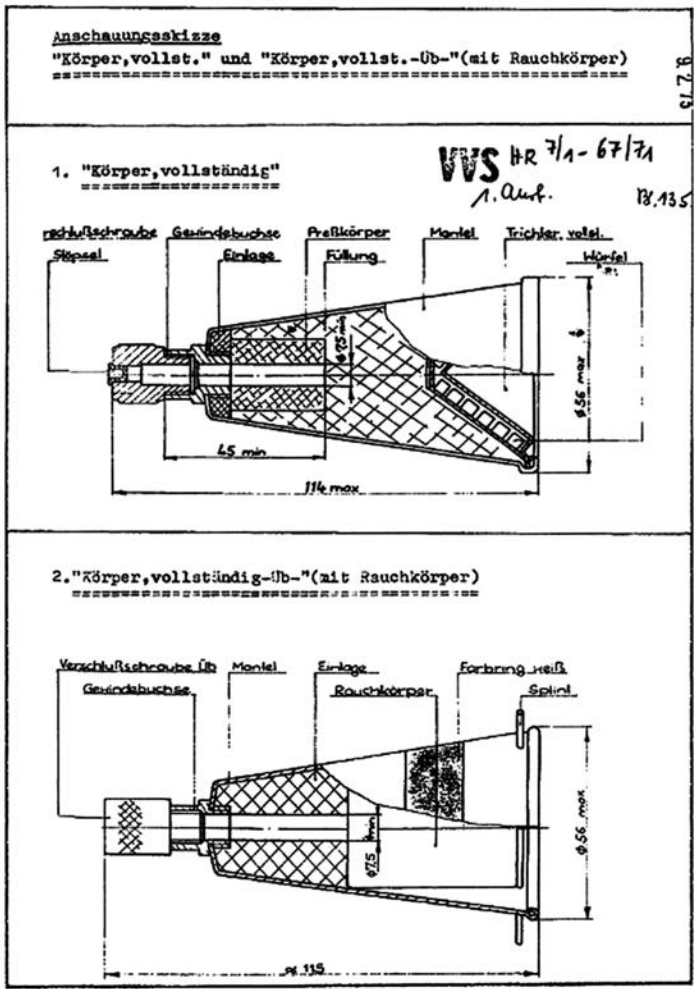


A sectional drawing of the SM-70.

splinter injuries and died of bleeding before the ambulance reached the hospital. Hoffmann was the first documented victim of an SM-70. After the technical features and the mode of operation of the killing machines had been described in detail by the western press thanks to Gartenschläger's dismantling coups, the number of GDR refugees who succeeded in crossing the death strip unharmed without activating the self-firing devices increased.

The SM-70 and SM-70/M systems incurred high operating costs. According to the files of the Ministry of State Security, the enormous number of 52,794 mines had detonated between December 1, 1974, and May 30, 1982, mainly by wild animals. Only 0.3% of these were caused by border violations.

At the beginning of the 1980s, the GDR needed financial support from West Germany. One of the demands on payment was the dismantling of all self-firing devices at the inner German border. The billion-dollar loan that the GDR then received from the Federal Republic of Germany indeed brought the desired success. The last SM-70/M was dismantled on November 30, 1984. Nearly all of them were scrapped, and today they are hard to find even in the memorial museums. SADJ



Construction drawings from February 1973. The lower one shows a training cone with smoke charge.

Sniper Tools Design Company's Angle Cosine Indicator—used by most military snipers under the NATO umbrella.

The Steep-Angle, High-Altitude Mountain Sniper

"One Round, One Down"

By Ward W. Brien

A *sniper* is a military/paramilitary marksman who engages targets from positions of concealment or at distances exceeding the target's detection capabilities. Snipers have specialized training and varying special operative battlefield roles. Fieldcraft, tactics, techniques and procedures (TTPs) catalyze their skillset that produces desired mission success.

All snipers begin with the "Basic Sniper" course, with the precision shooting course of instruction accomplished on a flat square range. The "flat square" is where the sniper learns about trajectory, wind boundaries, how the climatic conditions affect trajectory and accuracy, ranging techniques, the trending of the weapon, and so on. "Basic Sniper" is just that, "basic," and it's the beginning of the sniper's journey to maturity.

In the "urban" environment, it is very rare to engage a target beyond a distance of 400 meters. Theoretically, this is a very short distance; however, the top three concerns are as follows: 1) 6 o'clock security; 2) man-made winds; and 3) target acquisition time. The 6 o'clock security is self-explanatory; however, man-made winds and target acquisition time are not. When I say man-made winds, it is the difference of the wind speed at the base of a structure compared to the top of the structure, or the Venturi effect, that can be created when the wind is forced to go in-between two structures and will increase wind speed significantly. Soft

The Sniper Tools Design Company's Angle Cosine Indicator.

Students shooting upward at 15-inch dog targets. "One round, one down."

target acquisition time is a maximum of maybe 5 seconds. There is much more that goes into target engagements in an urban environment than one would think, though that is part of the TTPs.

Ranging is an interesting topic as there are different methods. Without using a laser rangefinder, the precision method is to calculate the distance to target with the standard equation of: (1m x 1,000) / target size in MILs = distance to target. During WWII, a designated marksmen or sniper utilized a technique using the front "dog ears and post" on their M1 Garand, which determined the distance to target out to 500 yards; today, there is another method that delivers extremely fast if not immediate distance-to-target readings and engagements out to 600m. There is nothing faster in reducing targets out to 600m than the use of a MIL-dot reticle—nothing.

Shooting at sea level in a flat AO does have its challenges; however, there is a unique and distinct difference when compared to the high-altitude, steep-angle, mountainous environment. One must experience this environment for himself to begin to understand it.

The challenges here are eye opening as the main components are: 1) climatic environment; 2) density altitude; 3) complex multi-layered and multi-vector winds; 4) steep-angle fire; 5) optical anomalies; 6) engagements beyond 1,000m; and 7) how these elements work in concert creating a puzzle that only the mature shooter can negotiate.

The climatic environment goes beyond temperature, barometric pressure and humidity; although these three components are what manufacture density altitude. Density altitude (DA) is a non-linear component to begin with, which affects the performance and trajectory of the projectile. When shooting at high altitudes at or above 8,000 ASL (above sea level), the density altitude changes dramatically, along with the performance of the projectile/cartridge. As an example, a .308 Winchester utilizing a 175-grain Sierra Match King at sea level will have a velocity at 1,000m of approximately 1,050 fps. However, at or above 8,000 feet ASL, one can expect an increased velocity of approximately 1,300+ fps at 1,000m. This increases the terminal velocity and delivers solid accuracy out to 1,200m, and that is shooting flat. 1,200m on 30 degrees of slope (.87 cosine) equal a corrected-for-gravity, distance to target of 1,044m; 1,450m

MSC's range #16.

on 30 degrees of slope equal a corrected-for-gravity, distance to target of 1,261.5m. Regarding angle fire / sloped distance to target, it is imperative that a method to correct the sloped distance to target to the corrected-for-gravity, distance to target be utilized. Whether in an urban or rural area, correcting for gravity is mandatory for precision fire. One tool that is utilized throughout the world is the Angle Cosine Indicator® (ACI) by Sniper Tools Design Company (**snipertools.com**).

The ACI is a vault-solid tool that is rugged, waterproof and mechanical; it does not rely on batteries or electronics, is extremely reliable and mounts onto the weapon via a Picatinny rail mount, ring or Spuhr® mount. Readings are instant, and failure is unheard of. The ACI is utilized by ranging your distance to target and then multiplying that distance to the indicated cosine numeral; i.e., .87. As an example, if your distance to target is at 1,000m, and you were aiming on a 30-degree angle, the indicated cosine numeral is .87. You would then multiply 1,000 x .87 = 870 meters. The Angle Cosine Indicator is a redundant device as the cosine numerals are laser-engraved onto the body, zig-zagging up and down in 5-degree increments.

If you are utilizing ballistic targeting software such as X-RING or AIM-E®, authored by Lyman Hazelton, Ph.D., the software will *very effectively* comingle the cosine / angle from the ACI with the projectile's ballistics (ballistic coefficient, or radar data, and velocity) with the current meteorological data to produce *extremely accurate results*—both the vertical and horizontal trajectory, out to extremely long distances and without fudging the software. Radar data is very unique as it takes 12 very expensive Doppler radar heads set up in an array to establish the data. Once implemented within the software, it then takes very specialized calculations to utilize the information. Doppler radar drag models are exchanged for a bullet's ballistic coefficient (BC) and have proven to be the most accurate method that can be used, "when utilizing the correct ballistic software." BCs are established at sea level and only in a temperature of 59 degrees. When at firing points that are located at 9,300 feet ASL, the bullet's BCs have changed dramatically. Its BCs along with the density altitude and barometric pressure will also change throughout the trajectory; i.e., shooting from 9,300 feet ASL down to 7,500 feet ASL. If you are an extreme long-range shooter, this is something to know.

The Mountain Shooting Center

There is a training venue within the United States called, The Mountain Shooting Center (MSC) (**mountainshootingcenter.com**). The MSC is a high-altitude (9300 feet above sea level), long-range shooting complex designed for the training of all advanced shooters and also military snipers who expect to engage targets at steep angles (up or down), and at long distances. Ward Brien, owner

The target above and on the right was engaged by "Mr. Trey Sprinkle" from a distance of 2,320m, with four lead sniper instructors from 10th Mountain Division as witnesses. His cold bore hit on the right collar bone with his follow-on hitting approximately 5 inches lower and 1 inch left of center with a 6.5 SAUM using a 142-grain Sierra Match King. "One round, one down."

of the MSC and Chief Instructor, has instructed U.S. Special Forces snipers, U.S. Special Forces lead sniper instructors, foreign snipers, contractors and hunters in the details of steep-angle, high-altitude, mountain shooting. As the proof is in the pudding, the real-world results speak volumes. The course(s) of fire are based on science that is comingled with over 50 years of high-altitude, precision mountain shooting. A quiet professional, Mr. Brien schedules his steep-angle, high-altitude, mountain shooting courses throughout the summer months or winter months in the Southern Hemisphere. His contact information is: **info@snipertools.com** or (818) 359-0512.

Altitudes at or above 8,000 feet ASL, angle of aim and density altitude play a very large role in mountain shooting. Still, there is more. One of those elements is humidity. In reality, humidity only makes up 1/10th of 1% of accuracy, or roughly 1/100th of 1 inch at 1,000 yards. However, if it has been raining for the last several days, and the shooter is perhaps running the meter lines at 0900, and the sun is out, the sun will cause high humidity at the ground level. This in turn will cause light refraction and an inversion layer that will produce negative results.

In addition to angle fire, wind(s) are another attribute that must be recognized and corrected for, just like on the flat square range. However, the winds in the mountains are very different. Not only will the shooters experience wind boundaries, but they will also experience layers of wind. As an example, on a ridgeline firing down, the wind at the muzzle may be an updraft of 8+ mph. However, 50 feet further out, the wind is a headwind, and then 50 feet below that wind, there may be another wind from 270 degrees with a velocity of 6+ mph, and perhaps one more as well. Now the complexity begins to be magnified. Add in the optical anomalies, angle fire and the other climatic conditions, and there is much to consider.

In regards to ballistics, snipers have been utilizing software for many years. However, to cut to the chase, in my opinion, there is only one ballistic targeting software that takes into account the many equations that produce real accuracy, and that is X-RING/AIM-E. It was authored by Doctor Lyman Hazelton, Ph.D., astrophysics/MIT. All other software on the market pales in comparison. Sorry, but I'm not a politician, and this is the cold hard fact. Without X-RING/AIM-E the shooters must rely on their recorded data in their data book, and that in part limits the ELR game changing distances. "One round, one down" is our motto.

The difference between the flat square range and the mountain range is draconian in nature. Yet one round, one down engagements in a mountainous AO are absolutely doable. "I have watched attendees at the Mountain Shooting Center go from having a very difficult time, to first-round hits out to 1,400 meters in a few days." The most common phrase mentioned at the end of the course is, "Mission Accomplished." SADJ

How Cartridge Cases Work and Fail

By Jeff Siewert

This article will cover the principles behind proper function of cartridge cases and some of the ways cartridge cases can fail.

How Cartridge Cases Work

Cartridge case design, done analytically, requires some fairly sophisticated computational models, as well as a skilled operator to construct the model, feed in appropriate boundary conditions and material properties inputs and to interpret results. Firing tests will also be required, of course, as any analytical model must be validated to provide reliable results.

The other approach to case design is empirical, which requires fabricating and fire testing a boatload of cases under a wide variety of conditions (high and low peak pressures, material processing and case material hardness, case exterior conditions like dust or lubricant, gun lock stiffness, initial case–chamber gaps, etc.) to ensure the case has enough structural robustness to transition to production.

The cartridge case is a handy, waterproof vessel that positions the primer, protects and contains the propellant and positions the projectile in the forcing cone of the firearm. The case is also a replaceable, high-pressure seal that is needed to keep the shooter safe and the gun functioning properly.

During the firing process, the case body is under stress from multiple directions from the internal pressure developed behind the projectile arising from the rapidly burning propellant. Figure 1 shows the component strains seen by each incremental section along the cartridge case. The axial strain is along the longitudinal axis of the case, the hoop strain is around the circumference of the case, and the radial strain acts to displace the case material outward in a direction perpendicular to both the axial strain and the hoop strain. Depending on the details of the interaction between the case and the chamber, the total strain at each point along the case length can change dramatically due to rapid shifts in one of the component strains.

Fig. 1: Cartridge Case Strain Components

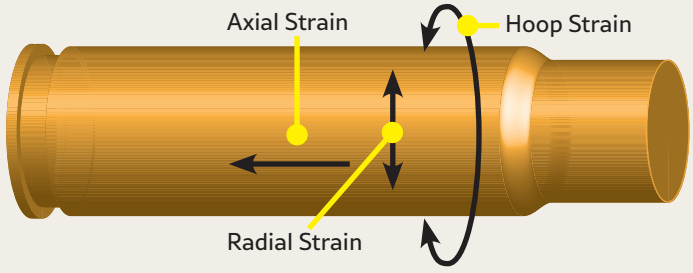
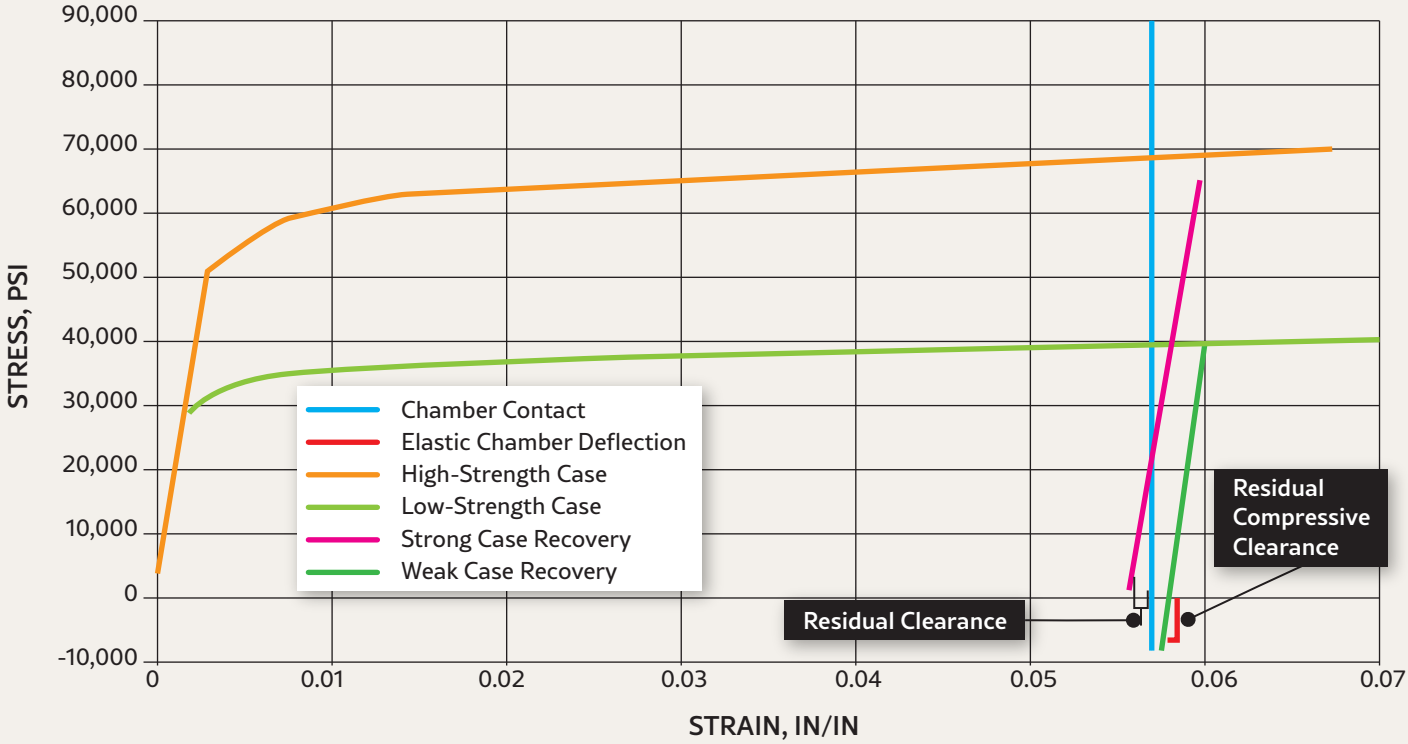


Figure 2: Cartridge Case Stress-Strain Behavior



Cartridge cases provide a reliable, high-pressure seal for the chamber because of the case wall thickness taper, material properties taper and (depending on the application) the exterior taper along the length of the case body (for rifle applications). The wall thickness taper makes the case thicker near the base and thinner near the case mouth, allowing the case to seal first nearest the case mouth. The case structure works best when the case material that is strongest (but least ductile) is at the case base, and the weakest (but most ductile) is near the case mouth. This material properties gradient arrangement, combined with the wall thickness taper promotes sealing nearest the case mouth first. The case taper (for non-revolver applications) aids in case extraction after firing for cases operating at high pressures.

Since the case material in nearly all cartridge cases is subjected to stresses above the elastic limit during firing, the case body taper helps to reduce the effort required to extract the case from the chamber. The extractor lip or flange provides a convenient handle by which to grab the case and pull it from the chamber. Most importantly, the cartridge case is a robust, replaceable seal against high-pressure gasses leaking aft.

Case materials with sufficiently high-yield strength to avoid stress above yield (like 200 or 250 maraging steel) are hard as well as ductile, making them usually expensive to fabricate and form. Thus, these high-strength materials are seldom used for case materials.

Most firearms and other structures in common usage are designed to operate well below the yield point of the material from which they are made. The "factor of safety" is a common measure of structural robustness for structures operating within their elastic limit; this is the ratio of yield stress to peak operating stress. This sort of assessment is appropriate for structures intended for multiple uses, where fatigue (failure due to repeated load application and removal) may be a factor in determining useful life. Fatigue failures start as small cracks that develop in a component at stress levels under yield stress. These cracks then propagate through the material due to repeated load cycling and resulting work hardening of the material.

Since cartridge cases are primarily designed to be "single-use" items (or reused only a few times) and they are stressed above their yield point at some point along their length, the traditional "factor-of-safety" structural margin assessments made for typical structures really aren't appropriate. For cartridge cases a different structural evaluation criterion is used, known as "percent of ultimate strain" to evaluate structural margins. If a material will elongate 50% before failure and a strain of 40% is caused by firing it, that item is operating at 80% of failure (40/50 = 0.80). By using a percent of ultimate strain failure criterion, an appropriate measure of the structural margin of the cartridge case is made.

There are six phases to the case–chamber interaction.

Case–Chamber Interaction Phases

Phase	Description
1	Initial Conditions/Weapon Interface
2	Propellant Ignition
3	Pressure Load Increase
4	Elastic Recovery
5	Residual Clearance / Unlock
6	Extraction

Case Operation

Each of the phases of case operation will be described briefly below.

- Phase 1: Initial Conditions. This phase covers the interior dimensions of the chamber, exterior dimensions of the case, the lock stiffness of the weapon, initial position of the case within the chamber (headspace control) and the initial temperature of the case and chamber.

Fig. 3: Case Wall Thickness & Case-Chamber Gap vs. Axial Location

- Phase 2: Propellant Ignition. This phase covers the firing pin strike of the primer, pressure rise in the chamber and propellant ignition, case wall radial expansion to contact the chamber, projectile overcoming case retention pressure, case axial movement relative to the chamber until the base contacts the bolt face after the bullet separates from the case.
- Phase 3: Pressure Load Increase. This phase covers the deflection of the chamber post-case contact, propellant combustion to peak pressure, thermal input to the case wall, through the case wall into the chamber, mechanical and thermal expansion of the case within the chamber.
- Phase 4: Elastic Recovery. This phase includes decrease of pressure after the projectile exits the barrel, elastic recovery of the chamber and the elastic portion of the case deflection, continued case temperature rise in the case until internal pressure is close to atmospheric pressure.
- Phase 5: Residual Clearance / Unlock. This phase includes residual stress between the case and the chamber, as well as between the case base and bolt face, if applicable.
- Phase 6: Extraction. This phase is the application of load to the case extractor lip and removal from any residual interference between the case and the chamber.

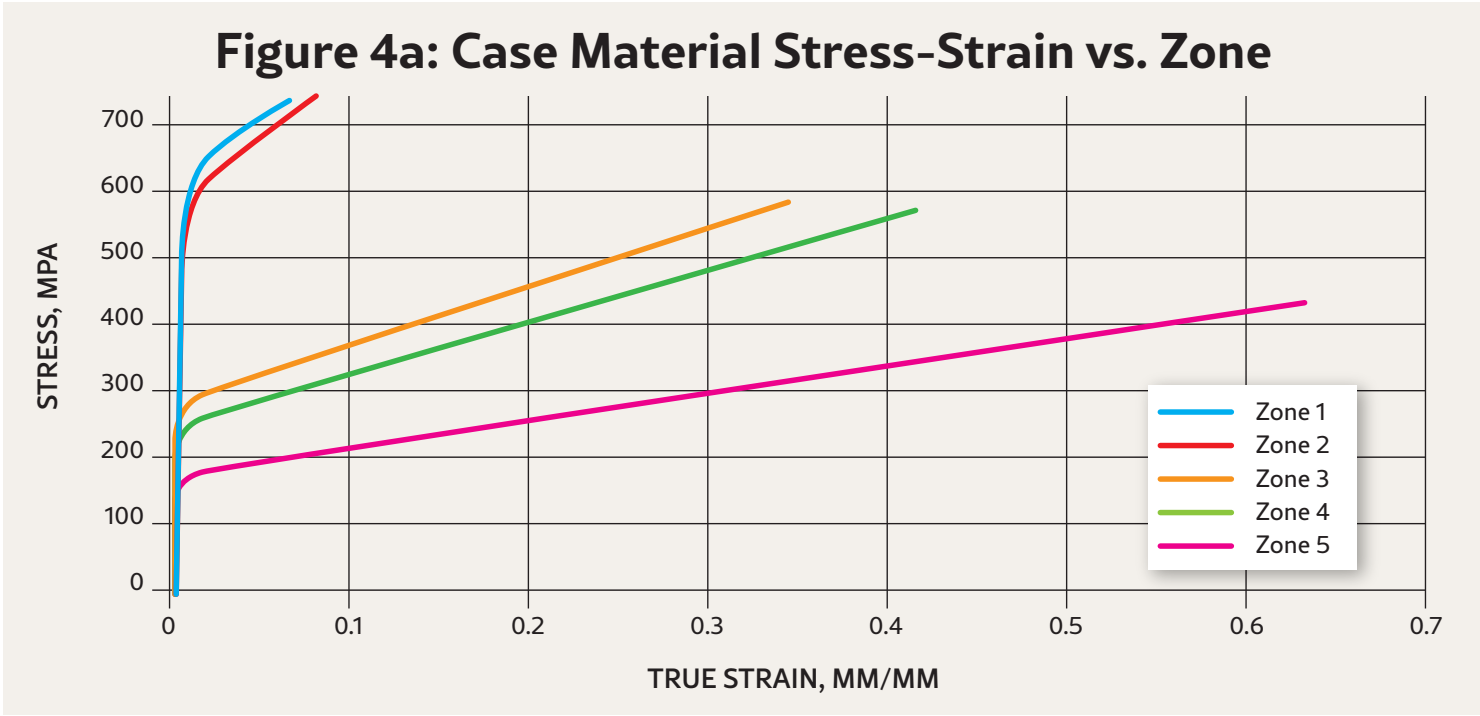
The interaction between the case and the chamber is a highly dynamic event, with multiple interacting facets to the non-linear interaction between the case and chamber. The effect of these interactions can only be studied in detail with specialized equipment and analyzed with specialized software. Typically, the case first contacts the chamber near the case mouth due to the thinner case walls and lower strength case material. As pressures continue to rise in the case, the contact interface between the case and chamber moves aft along the case, toward the base of the case.

The following non-linearities are present when analyzing case–chamber interaction:

- A mechanical non-linearity dealing with the contact of the case and chamber;
- The stress–strain behavior of the case material is typically non-linear since it has been pushed above its yield point;
- The effect of the dynamic thermal event from propellant combustion on case material properties further complicates the behavior of the case material;
- The case is (typically) tapered and contacts the chamber at different times along the length of the case.

All these factors serve to make analyses of the interaction of the case with the chamber exceptionally complex for such a "simple" mechanical device. Figure 2 shows the stress–strain behavior of a high-strength brass case section and a low-strength brass case section. The vertical blue line shows the case strain when the case contacts the chamber, while the vertical red line is the peak case strain. For the high-strength case material, the stress at chamber wall contact is just below 70,000 PSI, while for the low-strength material, the stress is about 40,000 PSI.

The residual clearance and compressive stress labels in the lower right-hand side of Figure 2 highlight the case strain state as the bolt is unlocked. Residual clearance is shown for the high-strength material and the residual compressive stress for a case made with low-strength material is also evident. The reason for the residual clearance or residual compressive stress is the difference in stress at peak strain and the slope of the case elastic modulus, along which the case material recovers as the pressure decreases. For the high-strength material, there is residual clearance as the pressure and stress decreases to zero, but for the low-strength material, the separation between the case stress and zero stress isn't large enough to prevent residual compressive stress between the case and the chamber remaining as the chamber pressure returns to zero. Thus,



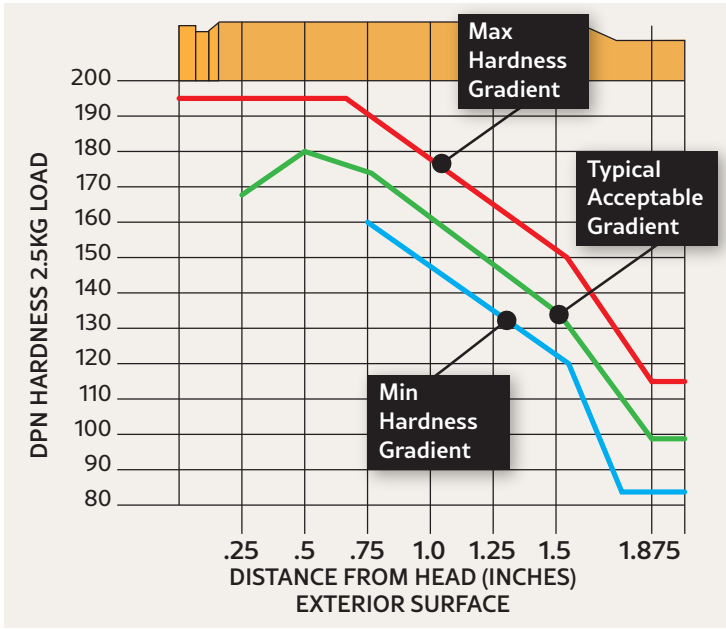


Figure 4b: Case wall hardness vs. distance from the case base.

the lower strength case has residual compressive stress between the case and the chamber at zero pressure, requiring a tug on the case to remove it from the chamber. If there is a taper on the interfering portion of the case, it only has to be moved aft a bit to eliminate the residual interference. Straight wall cases may have to move aft a considerable distance to remove the remaining stress between the case and the chamber and allow easy removal of the case.

Cartridge cases have both a thickness gradient and material properties gradient (e.g. hardness) that help them perform the function of high-pressure seal properly. Figure 3 shows the case wall thickness as a function of distance from the case base for a small caliber case, along with the nominal case–chamber gap. Note that the gap is zero at the shoulder for this shoulder-headspaced cartridge case.

Figures 4a and 4b show the hardness profile in a cartridge case as a function of distance from the case base. It also shows the corresponding true stress–strain behavior moving from the base (hardest, highest yield strength, lowest elongation at failure) to the case mouth (softest, lowest yield strength and highest elongation at failure).

Depending on the relative mass/energy of the firing pin and the clearances between the cartridge case and the chamber, and whether the bolt face contains a spring-loaded eject pin, the firing pin may move the case forward in the chamber until the shoulder of the case contacts the shoulder of the chamber. If the cartridge mass is sufficiently low and the case is free to move, the firing pin strike can transition the case forward in the chamber until it meets the headspace stop. This forward movement of the case, or the spring-loaded eject plunger, causes a gap between the case base and bolt face. For tapered cases, this forward movement provides minimum radial gap between the case and the chamber. At some point, the case meets resistance with the chamber, and the firing pin energy is dumped into deforming the primer cup. The primer mix is pinched between the interior surface of the primer cup (deformed by the impact of the firing pin) and the anvil, and the primer mix detonates. The mix is converted to hot particles and gas almost instantaneously, and the pressure starts to rise in the primer pocket. If the primer cup is rigidly attached to the case primer pocket via lacquer and crimp, the primer cup cannot move aft relative to the cartridge case as the pressure starts to increase in the primer pocket. If the cup isn't held in place by the belt and suspenders of lacquer and primer pocket swage, the primer cup moves aft relative to the case as the pressure rises in the primer pocket until the cup hits the bolt face.

As the ignition process proceeds, hot, particle-filled gas passes through the flash hole(s) in the case base, transferring the flame front to the propellant bed. At this point, the propellant starts to burn due to the contact of the hot particles from the primer gasses coalescing on the exterior surface of the propellant. As the propellant burns, it changes from a solid into a gas, causing the pressure to rise in the case. The case then starts to swell in both length and diameter. Ultimately, the pressure increases to the point where

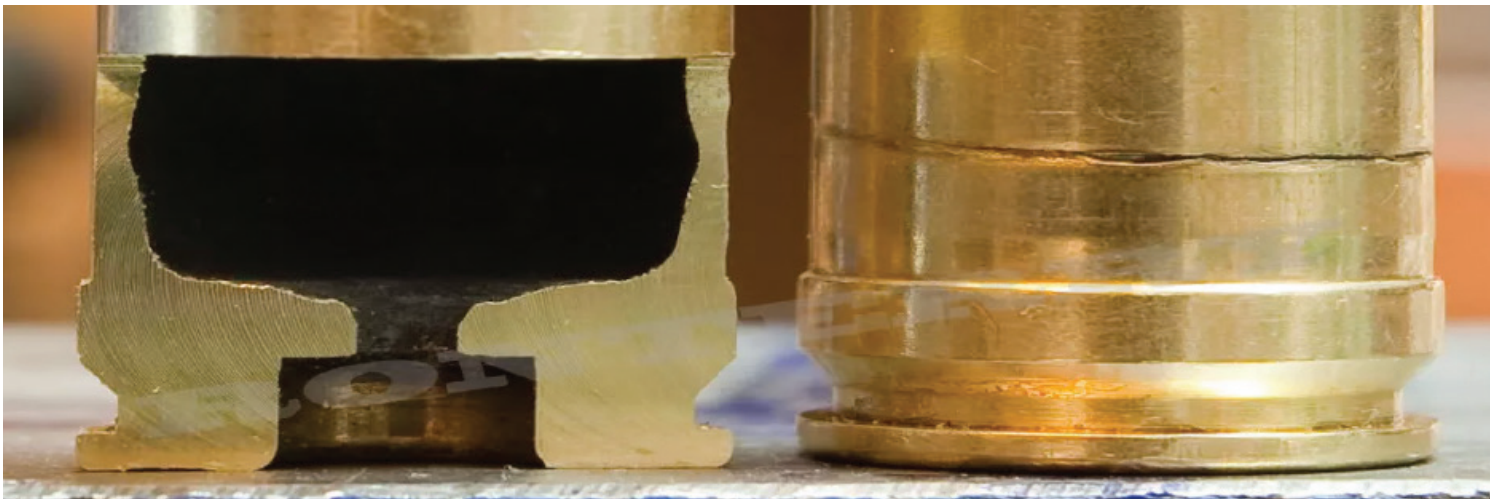


Figure 5: Case necking failure.

it overcomes the crimp and/or friction of the case mouth restraining the bullet, and the bullet is dislodged from the case. Once the projectile overcomes the case retention force and the bullet starts to move, the case can then move aft axially due to the unbalanced pressure load acting on the case. If the primer has not been properly restrained relative to the case, the aft movement of the case can pinch the primer cup between the case base and the bolt face, causing structural failure.

Initially, the pressure in the case continues to rise as the projectile proceeds down the barrel from the gases evolved from propellant burning. Upon attaining a sufficiently high pressure in the case, the case wall deflects outward enough to contact the chamber, and the case base contacts the bolt face. Once the case wall contacts the chamber and bolt face, the case walls are supported by the strong (typically) steel structure of the firearm, and the case starts transferring thrust aft to the firearm.

The case is thinnest near the case mouth and gets progressively thicker near the base of the case. This thickness gradient, combined with a strength gradient that puts the material with the lowest strength at the case mouth, makes the case contact the chamber near the case mouth first, causing the case to seal there early in the combustion process. As the case contacts the chamber wall, the chamber supports the case due to the mechanical stiffness of the barrel or cylinder. At the same time, if the friction between the case wall and the chamber interior is sufficiently low, the case moves aft in the chamber relative to its initial position due to the unbalanced load generated by the release of the bullet from the case mouth, eventually causing the case base to contact the bolt face.

The pressure in the case continues to rise, and the contact point between the case wall exterior and the chamber moves from the case mouth aft toward the case base, helping to prevent leakage past the case. The case stretches in the radial and hoop direction until it hits the chamber and along the axis of the case. The stretch along the axis of the case is limited by the coefficient of friction between the case and the chamber forward of the last contact point and the internal case pressure. As the contact point moves aft with increasing pressure, progressively more contact area is engaged between the case and the chamber, and more load can be reacted in shear through the contact area between the two structures. The increasing internal pressure and case–chamber contact area increases the axial load carried by the case wall, with maximum axial stretch (and hoop stretch) occurring just aft of where the case wall last touches the chamber. The large combined stretching just aft of the point of last case contact with the chamber wall causes the case wall thinning frequently seen in the aft portion of cases fired multiple times.

How Cartridge Cases Fail

Cartridge cases that make it past the design and evaluation phases aren't expected to fail due to "structural overload" (e.g., see a region with percent ultimate strain > 100%) on the first firing, but cases can still fail in numerous ways, some of which the shooters themselves are responsible for causing.

Necking of the case just aft of the point of last contact with the chamber causes a signature, circumferential failure of the case, as shown in Figure 5, courtesy of: **http://i338.photobucket.com/albums/n420/joe1944usa/338.jpg.**

This structural failure is due to:

1. Large combined strain in the section just aft of the last point of contact with the case, largely driven by the axial strain at this section;

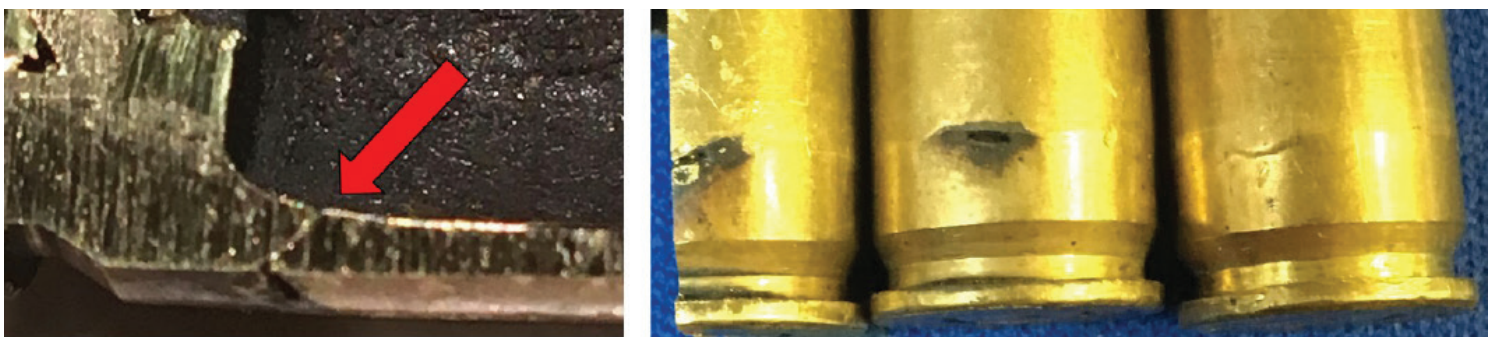


Figure 6: Brace case leak *(left)* due to repeated sizing and reduced elongation at failure (*right*).

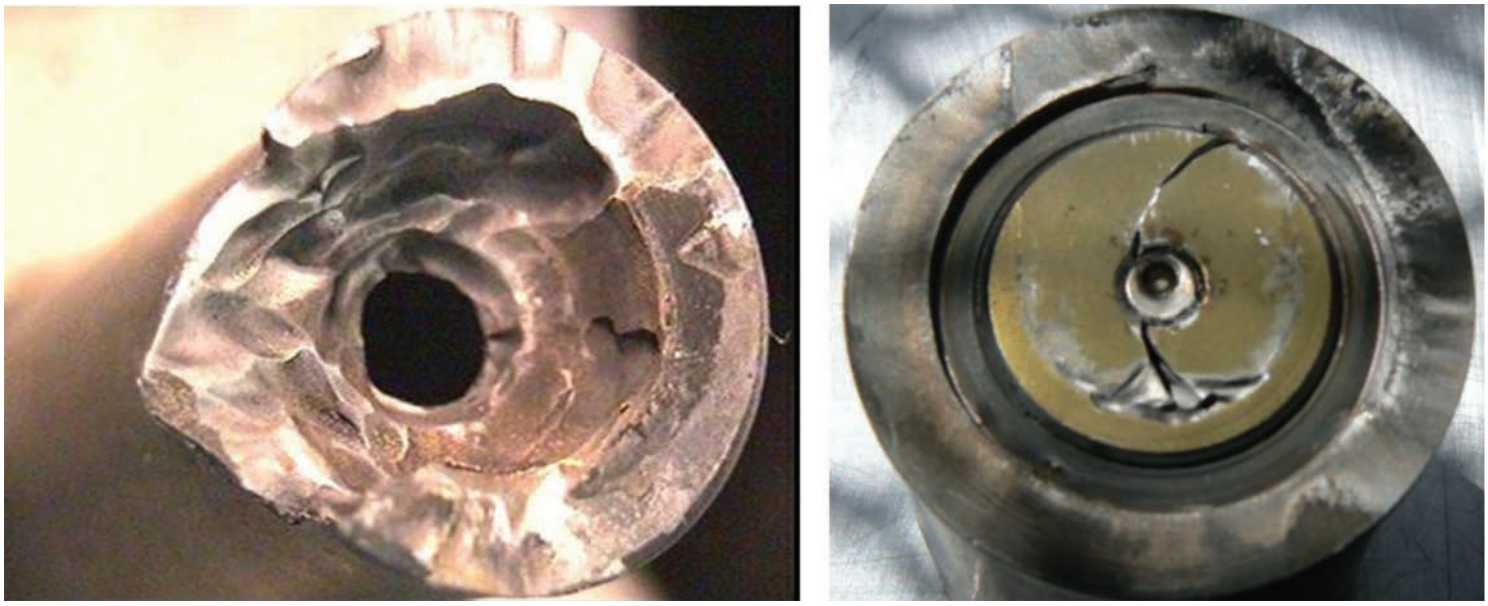


Figure 7: Failures of improperly processed aluminum cases.

2. The low strain at failure in this section of the case caused by the high hardness of the brass;
3. Repeated sizing and firing.

Another common failure caused by repeated firing and resizing of the case is shown in Figure 6. The repeated firing and resizing causes the case to experience "cold work" which raises its yield strength, but this increase in hardness also reduces the material elongation at failure. A reduction in elongation at failure really translates into an increase in "brittleness," meaning portions of the case that once could be stretched to say 5% before the case failed, can now only be stretched 3% before the material fails. Figure 6 shows a brass case that failed due to repeated firing/sizing cycling and resulting reduction of elongation at failure near the base of the case. On the left (in Figure 6) is a section through the case wall near the case base, with a red arrow indicating the failed case section. On the right of the figure is a photo of the exterior of the cases; leftmost is the case shown in the left photo, plus two other cases. The middle one has also failed, and the one on the right-hand side is about to fail. In this particular location, the case is fairly hard, but this region has little elongation as a result. These cases had been fired a maximum of four times, and there is little doubt that work-hardening from repeated firing and resizing has reduced the elongation at failure in this region of the case.

In a related vein, case material can be improperly processed or heat-treated, leading to a case occasionally "sneaking through" the manufacturing process that will fail when subjected to "normal" firing pressures on the first shot. Figure 7 shows some examples of failures of improperly heat-treated aluminum cartridge cases. This is not to disparage aluminum cases; it serves to illustrate what can happen if the material is not processed properly.

A more insidious case failure can occasionally be seen in brass cases caused by a condition known as "stress-corrosion cracking." Stress-corrosion cracking (SCC) happens when a material that is susceptible to a particular corrosive environment also has residual internal stress remaining from the forming process. Brass is particularly corrosion-sensitive to compounds containing free nitrogen (not molecular nitrogen in the atmosphere), and for most metallic cases, there is some level of residual stress left from making the case to a particular hardness. Since modern smokeless propellant contains copious amounts of nitrogen in the form of nitrocellulose, the corrosive environment is present with the case. As previously mentioned, residual stress is present from the case-forming process, or it can be caused by the interference fit of the projectile into the case mouth. So, the three factors required for stress-corrosion cracking are

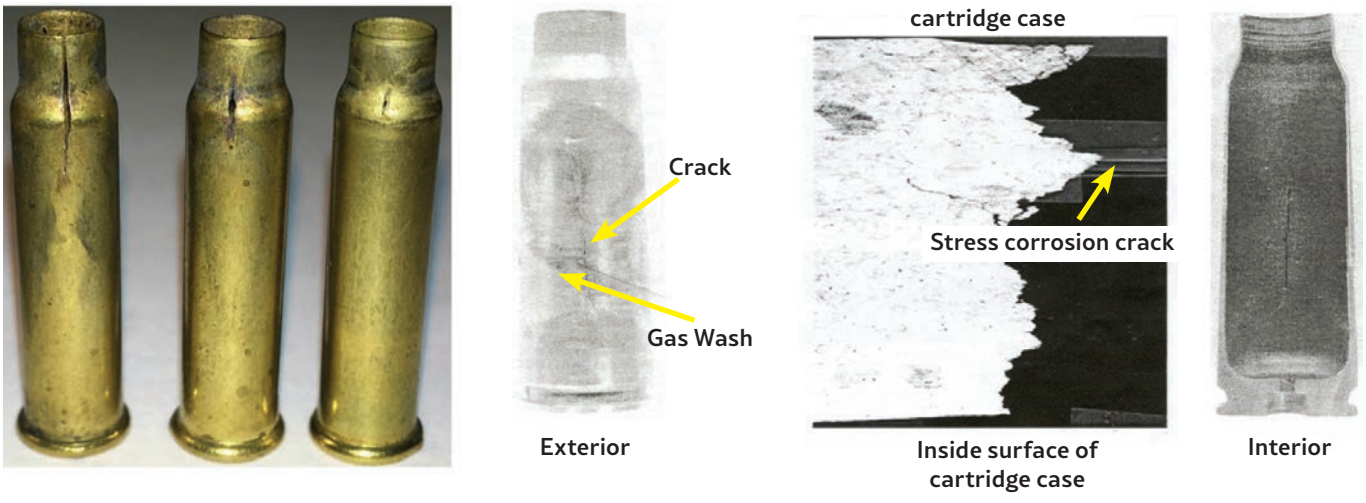


Figure 8: Examples of stress corrosion cracking in brass cases.

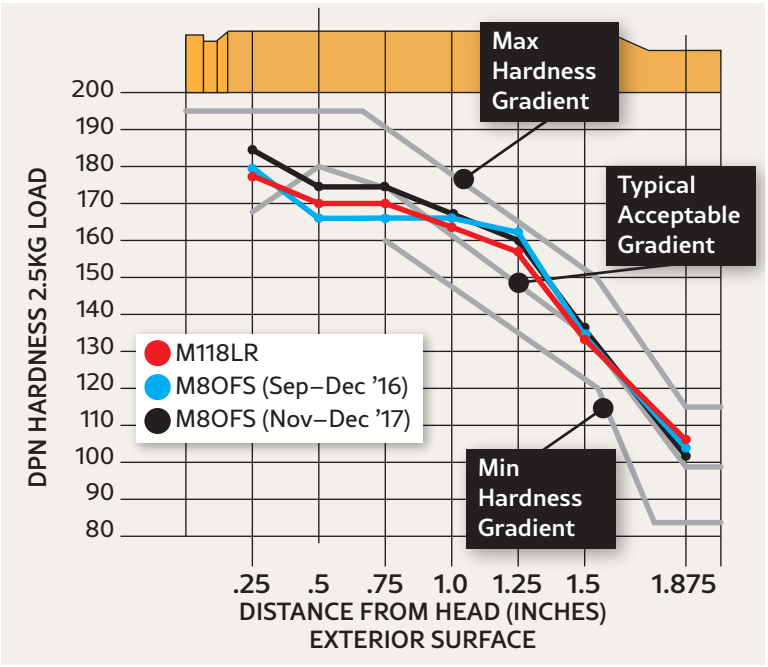


Figure 9: Case hardness gradient specification, *left*; photo of failed case, *right*.

present in most brass cases.

Figure 8 shows 17 HMR cases on the left suffered from varying degrees of stress-corrosion cracking during firing, while on the right, a 20x103mm brass case with stress-corrosion cracking is shown. On the right, interior and exterior photos are shown, along with a microphotograph of a section through the crack.

Stress-corrosion cracking is initiated at the interior surface of the case because that's where the corrosive atmosphere is located, and the crack will run toward the exterior surface until the stress falls below the level required for propagation, at which point the crack stops running deeper into the case wall. The exterior of the case looks fine until the cartridge is fired, at which point the crack immediately runs through the case wall to the outside, allowing the case to leak as shown in Figure 8. Generally, the case aft of the crack seals the high-pressure cases in the chamber, preventing unrestricted venting to the atmosphere aft of the case. As a result, these sorts of case failures usually do no harm to the weapon providing the cases are brass or steel and there is nothing in the gun mechanism to promote cracking in a preferred location in the chamber.

A condition known as "dezincification" can occur in brass cases; this is where the zinc doesn't stay in a solution with the copper with which it is mixed. Dezincification will enhance the likelihood of a case experiencing stress-corrosion cracking.

Another failure mode for cartridge cases is one of improper hardness gradient. As mentioned above, a thickness and hardness are required for the case to survive peak pressure, unlock and extraction. If the case hardness gradient isn't correct, however, the case can fail at the location where the hardness change is greatest. The left-hand side of Figure 9 shows the upper and lower hardness specifications for the 7.62x51mm cartridge case, along with some examples that function acceptably and one hardness gradient example that results in the case separation failure shown in the right-hand side of Figure 9. (See **ndiastorage.blob.core.usgovcloudapi.net/ndia/2019/armament/Krogstad_SA3_3PM.pdf** for more detailed information.)

This failure should be of particular concern to hobbyist shooters who are inclined to anneal cartridge case necks and

Figure 10: 9x19mm case exhibiting catastrophic internal pressures.

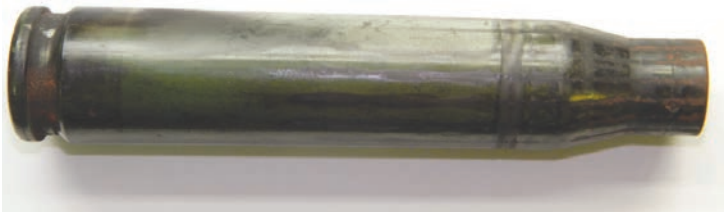


Figure 11: Case exterior fired in fluted chamber.

shoulders in their efforts to extend case life or reduce group size because while the process used for annealing can be controlled, testing of the hardness gradient is not something most shooters are capable of measuring. This leaves the shooter with "trial and error" or "shoot to failure" as methods of determining the adequate amount of case mouth annealing.

Lastly, there is the "catastrophic overload" failure of the cartridge case structure. Figure 10 shows a 9mm Luger case (9x19mm) that experienced catastrophic internal pressures. The primer pocket internal diameter should have been 0.210 inch. It was measured at 0.227 inch; the thickness of the case web on other cases made by the same manufacturer was measured at 0.168 inch, and the web thickness of the failed case was measured at 0.122 inch.

The chamber pressure required to fail the cartridge case, based on a typical hardness profile, was estimated at 95,000 PSI; pressures inside this case are believed to have been well in excess of that. The shortening of the strongest part of the case, the web, the increase in primer pocket diameter and the rupture of the case base are primary evidence of a significant overpressure event. My thoughts on how this likely happened are the topic of another article.

Other Case–Chamber Interaction Factors

There are numerous other case–chamber interface factors that affect case and firearm function, some of which aren't controlled by SAAMI/CIP. Among these factors are:

1. Case-hardness profile;
2. Weapon-lock stiffness; and
3. Presence of flutes in the chamber.

The Case-hardness profile, discussed above in the case function and case failure sections, is not controlled by commercial interface documents maintained by either SAAMI or CIP. Instead, it is left to the ammunition manufacturers to perform a "function and casualty" test in firearms commonly chambered for the ammunition in question.

The Weapon-lock stiffness is a measure of the mechanical compliance of the weapon's barrel-bolt-receiver load path. The lock stiffness can be determined by testing or analytically with an accurate 3D model; the load applied to the bolt, divided by the deflection of the bolt relative to the aft face of the barrel is the lock stiffness. The lock stiffness affects the strain the case must survive to provide a reliable seal, but as mentioned above, this parameter is not controlled by SAAMI/CIP. Instead, the previously mentioned "function and casualty" test conducted in weapons commonly chambered for the subject ammunition is a de facto control of this parameter.

Some weapon manufacturers put "flutes" in the chamber of the weapon to reduce the axial stretch of the case. By etching longitudinal grooves in the chamber, weapon manufacturers vent a tiny bit of combustion gas to the forward portion of the exterior of the case, reducing the contact stress between the case and the chamber. This reduces the case stretch in all three directions since it limits load transfer in shear between the case and the chamber in the longitudinal direction. The reduction in between the case and the chamber increases the load that has to be reacted by the bolt. The reduction in case stretch does, however, dramatically reduce the residual load between the case and chamber when the pressure is removed from the inside of the case. This makes the weapon easier to unlock and the case easier to extract, regardless of the stress–strain properties of the case material. When implementing fluted chambers, the weapon designers have to take the increased bolt load into account when designing the gun lock mechanism. Figure 11 shows the exterior of a cartridge case that has been fired in a weapon with a fluted chamber. The case neck, shoulder and forward part of the body show the signature of propellant gas vented along the chamber flutes. SADJ

Uselton's state-of-the-art M1911 (IA-CQR) (Close Quarter Rail) .45 ACP aluminum/ stainless steel, explosively bonded frame and slide (*left*). Unloaded weight is only 28 ounces. 20th century all-steel Colt 1905 (*right*) designed by John M. Browning.

Firearms Mate

Explosive Bonding, ZK Magnesium Alloy and Cryogenic Treatment

Story & Photography by Paul Evancoe

There are numerous M1911 pistol variants being manufactured today by dozens of companies worldwide that include variations in frame sizes, barrel lengths and calibers of the basic M1911 design. Many claim to have improved upon the design, but one might question if that can be effectively accomplished without sacrificing reliability. In actuality, reliability does usually suffer. So, can one of the greatest self-loading pistols ever designed and manufactured be improved upon? That conundrum has a simple answer according to Rick Uselton, founder and CEO of Ultimate Arms (UA), a Tennessee-based arms man-

rial Innovation

ufacturer. His solution is to reduce the M1911's overall weight without any major design modification. How Uselton accomplishes this feat is unique, from both an engineering and material perspective.

Explosive Bonding

Uselton creates an exotic bimetal billet by bonding ferrous and non-ferrous metals (in this case, 304 stainless steel and 6061 aluminum) for frame and slide machining, using a space-age process known as "explosive bonding." This process involves taking two dissimilar metals, ferrous and non-ferrous that could not otherwise be welded together, and explosively bonding them at the molecular level. While the explo-

sive bonding process was accidently discovered during the American Civil War as a result of large explosives piles detonating and bonding metal to metal that was in contact with the explosion, the process was neither understood nor developed into a controlled process until the mid-20th century.

Today's explosive bonding process, also known as molecular bonding, employs modern high explosives with a high velocity of detonation (basically, a full-size explosion, and you are correct to assume this is not done indoors). The explosion, drives the dissimilar metals into one another at ultra-high velocity under tens of thousands of pounds of pressure, causing their granular structures to bond (join) at the molecular (atomic) level. Visualize two (or more) metal plates laid flat, one on top of the other, on a flat anvil. The plates' adjoining faces must be hermetically clean to ensure a perfect molecular bond. An appropriate amount of high explosives is evenly distributed on the top plate so as to fully cover the plates to be joined beneath. The explosives are detonated, and a solid bimetal billet is instantaneously formed from which the pistol's frame and slide can be subsequently machined.

Uselton machines his 1911 bimetal billets so the stainless steel is located on the bottom of the slide and the top of the frame. Thus, all the mating wear points are made from stainless steel while the bulk of the slide and lower frame (the otherwise heavy frame parts) are made from aluminum. This significantly lightens the entire 1911 without sacrificing durability, maintainability and, most importantly, reliability. In fact, it actually increases all three, especially in a wet corrosive environment (think tropical jungle and maritime operations). It's no less than metallurgical brilliance and Uselton has given Browning's superbly designed 1911 a material face lift after a century of service to the U.S. Armed Forces, firearm enthusiasts and hunters alike.

Looking back, here's some pertinent chronology. In 1960, a patent for explosive bonding (filed on October 26) was submitted by George R. Cowan, John J. Douglass and Arnold H. Holtznian on behalf of the E. I. du Pont de Nemours and Company (widely known as DuPont™), from their Wilmington, Delaware, headquarters. A top U.S. chemical and composites maker, DuPont consists of 13 businesses that are divided into eight segments, each of which serves a diverse set of markets. In April 2011, SOURIAU PA&E engineer, Nelson Settles, filed for the first patent to use the technology utilizing explosively bonded metals in the manufacturing of firearm components. There are currently a number of application-specific patents around the firearm industry, but SOURIAU PA&E owns two patents filed with coverage in the United States, European Union and Japan, with Rick Uselton (personally, not his company) holding exclusive rights to materials application in the aforementioned areas with specific regard to manufacturing the 1911.

The magnitude this technology offers (costing roughly $5 USD per square inch to manufacture, and as demand grows the cost will decrease) for future weapon material construction was recognized once Rick made UA's headquarters a testing ground for the explosive bonding technology. Ricks explains, "Lightening the soldier's load is a worthy goal. Molecular bonding, for example, allows us to lighten the 1911's weight by at least 45%, reducing the 1911 weight from 46 ounces to 24 ounces [depending on the model of the 1911]."

Uselton's .50-caliber BMG Warmonger bolt-action sniper rifle has a 31-inch, cryogenic 4.5-pound barrel with a 1-in-15 RH twist / 4 lands and grooves. Overall weight, with an 8-inch recoil break, is only 14 pounds.

Before molecular bonding, other attempts to use lighter metals resulted in a weapon that wore out faster, especially in conditions where the gun is operated in extreme environments such as desert conditions of the Middle East, the tropical rainforests of the Southeast Asia and the Arctic. Using steel and aluminum molecularly bonded parts as the substitute for virgin metal does not sacrifice durability (weapon life) or reliability to achieve weight reduction.

Also, the aluminum portion of the bimetal construction is non-magnetic and naturally non-corrosive. Additionally, aluminum dispels heat rapidly which helps keeps the gun cool, even after rapid fire. Uselton really has perfected the "magic" combination of metals that performs perfectly under strenuous military combat situations. That said, there are 33 metals that can be explosively bonded for firearms use, which allow UA to change formulas as the price and availability of various metals fluctuate. Uselton is quick to point out, "If we can lighten the load by even a few ounces—ask anyone that has walked a mile wearing full combat gear—every ounce makes a difference."

More recently, Uselton has worked on a new firearms application for an innovative, lightweight magnesium alloy called "ZK material." Magnesium is the lightest metal known, as well as the sixth most plentiful metal on earth. Uselton's proprietary ZK material alloy is made by blending magnesium with zirconium and zinc to yield a very hard, silvery metal that is highly resistant to corrosion and won't burn. Zirconium metal is produced commercially by first converting zircon to zirconium chloride, then reducing the chloride and blending the resultant metal with magnesium. The alloy's strength is then increased from the as-fabricated form through a process known as artificial aging. This proprietary process is performed at one or more elevated temperatures, which are usually in the range of 150°C to 200°C. The ZK alloy is heated for specific times lasting between several hours to days, depending on the part size and the desired amount of hardening. During ageing, the ZK alloy undergoes a series of chemical and microstructural transformations that have a profound impact on the ZK alloy's mechanical and corrosion properties. Thus, of all the wrought magnesium alloys, magnesium ZK alloy possesses the best combination of strength and ductility at an average operating temperature of 75° Fahrenheit making it perfect for firearms applications.

Once again, Rick decided to set his company's goals to designing the finest custom production and lightest weight 1911 ever, by applying the best metal technology available. Soon after, he premiered the MagnaT5® 1911 model constructed from ZK magnesium. Compared to other custom 1911s, Uselton's wholesale pricing for the MagnaT5 is below the $2K mark, depending on the model's features, and as production quantity ramps up, pricing will be reduced. Options for upgraded (tricked out) models and features are priced accordingly, depending upon volume ordered, and UA offers four dealer packages. Remarkably, Uselton has not stopped there.

Cryogenic Treatment

UA has applied another space-age metallurgical process to UA manufacturing utilizing cryogenically treated rifle barrels. Cryogenic treatment of metals has been around since the middle part of the 20th century and has been used for applications on race car

Uselton chambers his Warrior Tactical Lite in 7.82/.308. With a 180-grain bullet, it achieves 3,800 to 4,000 FPS and delivers 5,000 ft/lbs of energy at 100 yards. It is arguably the flattest-shooting and hardest-hitting .30-caliber rifle ever offered.

brake discs, engine parts, cutting tools, knives, surgical tools and scalpels, drill bits, musical instruments (e.g. brass instruments, piano wires and cables), as well as other metal parts that are exposed to high heat, stress and wear. How does it work on gun barrels?

Cryogenic hardening (gun barrel treatment) is a process that uses cryogenic temperatures (–310°F) to strengthen and enhance the alignment of a metal's granular structure. The proprietary process involves using liquid nitrogen to slowly cool the gun barrel from ambient to cryogenic temperatures to avoid thermal stress. The barrel is then submerged in liquid nitrogen and held at a minus temperature of around –310°F for 20 to 24 hours. Following this deep freeze, the barrel is allowed to slowly return to ambient temperature. Liquid nitrogen is made from air in the atmosphere so there are no environmental consequences involved in the cryogenic treatment process.

Cryogenic treatment changes the entire microstructure and mechanical properties of a metal throughout, not just its surface. Therefore, its benefits are not lost as a result of fine tolerance machining or finish grinding. Cryogenic hardening is most effective in enhancing heat-treated martensitic steels, such as high carbon and high chromium steels (gun barrels), as well as tool steels. In addition to steel, this process is also used to treat cast iron, copper alloys, aluminum/aluminum alloys and magnesium/magnesium alloys (Uselton's ZK magnesium alloy). The cryogenic process significantly improves the wear characteristics (life) of these types of metal parts by factors of two to six, and that directly applies to gun barrel life; e.g., greater durability, improved wear resistance, corrosion resistance and improved heat transmission.

These improved metallurgical properties provide Uselton the ability to use a lesser diameter–lesser weight barrel without sacrificing strength or reliability, and that's why he intends to offer cryogenically treated barrels for all UA. Better yet, when you combine Uselton's ZK material in an M4's upper and lower and a cryogenically treated barrel, you get the lightweight M4-AR Black Widow®. The Black Widow weighs in (unloaded) at a mere 5.6 pounds and is arguably the lightest weight and most durable AR on today's market. These custom AR rifles range in price from $1,500 to $2,300 USD.

Manufactured from these same high technology materials, UA also offers a 6.5-pound, centerfire bolt-action (long-action) sporting rifle, the Warrior Mountain Lite®. It is chambered in UA's flagship round, the 7.82/.308 Lazzeroni® Warbird®. The 7.82 /.308 is simply the hottest and fastest .30-caliber round on the planet, with bullet speeds exceeding 3,800 FPS (feet per second). At 100 yards, it groups within an inch and a half, utilizing a 150-grain bullet to a 180-grain bullet, while delivering 5,000 ft/lbs of energy. UA also offers custom chamberings in all the other long-action calibers such as .300 MAG, 7mm MAG, etc.

Another new exciting offering from UA is the Warmonger® bolt-action sniper rifle chambered in .50-caliber BMG with a 5-round side-load magazine. Warmonger is currently offered

Uselton's M4-AR Black Widow chambered in 5.56 NATO, has both the upper and lower machined from T-5 forged magnesium-zirconium billets. Barrel length is 18 inches and is available with a cryogenically treated barrel to improve barrel life 200%–300%. The stock is fully adjustable. Remarkably, the gun's total weight unloaded is only 5 pounds, 6 ounces.

in 18-, 24- and 31.5-inch barrel variants and encompasses Uselton's cryogenically treated, lightweight barrel design with a 1/15 right hand twist consisting of four lands and grooves. The combination of ZK magnesium construction and cryogenically treated barrel has allowed Uselton to reduce the gun's overall weight, compared to similar conventional-style guns, by approximately 50% while increasing overall frame and barrel life by 200%. Uselton is currently designing a Warmonger variant that has a bottom wide body double-stack lower with a 5+1 magazine. This will provide the shooter an ammunition quick-change option as well as a tactical fast reload capability.

Recap

It is an exciting time to be in the firearms industry for all who relish technology's cutting edge processes like molecular bonding, ZK magnesium and cryogenically treated barrels. Meanwhile, Uselton continues to develop and apply these and other innovative materials and processes to firearms improvement. One can only wonder what's next. For more information visit **uaarms.com.** SADJ

.308 accuracy setup Advanced Weapon Technology 20-inch .308 with Nikon® Tactical .308 4x16 and Sea Horse case.

Running Ammo

An AWT LEO .308 Ammunition Accuracy Test

By John Bibby

With all accuracy tests, there are a few things that need to be taken into consideration. The first is can the shooter shoot straight? I will not claim to be the best shot, as I know it isn't true; but I am a good rifle shooter. Second, if the shooter is good enough, is the rifle? The Advanced Weapon Technology (AWT) LEO .308 Sniper platform shoots better than this shooter; users can decide from the groups if the rifle was up to the task. You need a pile of ammo choices. Then, lastly, you need to have a method.

The rifle is not a benchrest gun, so I did not attempt benchrest protocols. It is a LEO Sniper rifle built on Don Fraley's proprietary Remington 700 (Tomahawk) action, with just over a 20-inch barrel and a Timney Trigger 590 trigger set at 2 pounds.

The writer's method was to shoot prone, from a rest with sandbag support at the rear of the gun. Three barrel warming shots were taken at the beginning of each shooting session. A three-shot group was fired, unless the shooter shanked a shot. As much as the writer hates to admit it, shooter errors happen, and shooter-induced flyers were re-shot and removed from the group score. No group had more than one such flyer. After each group, the shooter

Federal Gold Medal Match with Sierra 168-grain BTHP group.

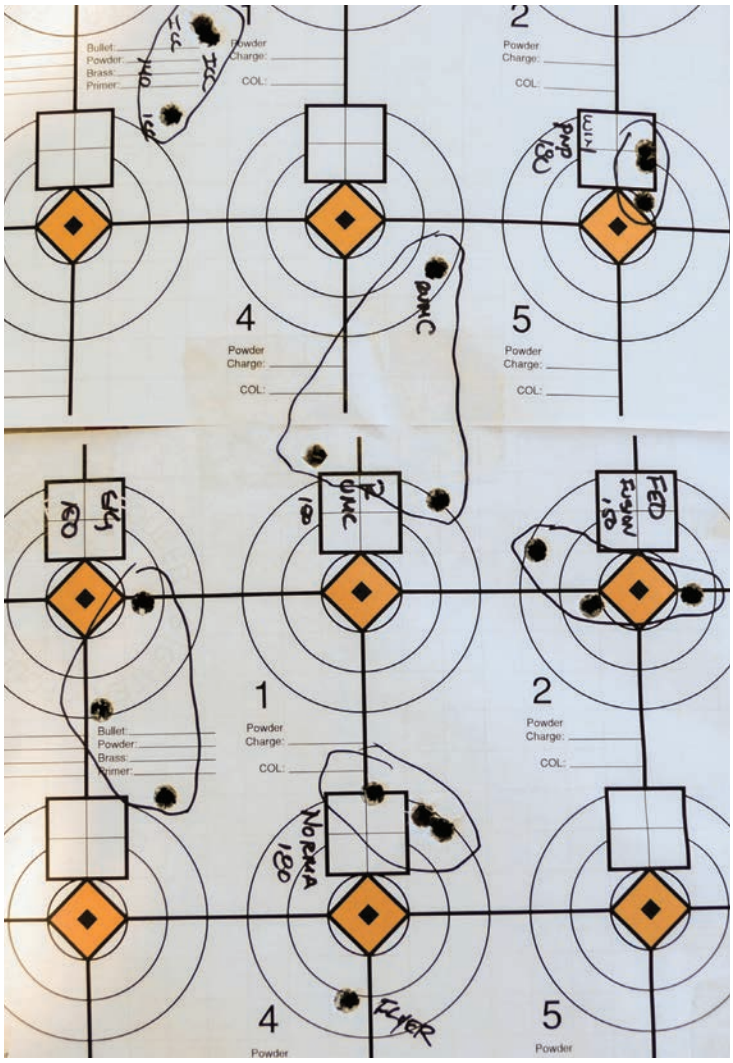
opened the bolt and walked the 100 yards (and back) to label the ammunition used on the target. This allowed the barrel to cool a bit between strings, yet kept the barrel temperature fairly consistent between three-round groups.

Due to time and ammunition constraints no more than four three-shot groups were fired per variant. Two variants got fired a lot less. I have a very small supply of ICC Frangible ammo, and only one group was fired, so the best and worst groups are the same. The second oddity was the Nosler® Match Grade™. The first round I attempted to chamber gave STRONG resistance to closing the bolt. I tried a different round. It was a snug fit but not overly snug, considering the rifle is a custom accuracy platform. The round hit the target quite close to the point of aim, but the recoil felt a tad off. More importantly, the bolt was STUCK. I was able to pound on the bolt with my palm to get it open. It took several tries, and I thought I was going to have to resort to the old Mosin–Nagant trick and recruit the "2x4 of Persuasion."

Two possibilities come to mind that could cause such an issue. The first is an excessive powder charge. I don't think that was the issue, despite the recoil being a bit different than the preceding brand. There is often a change in the recoil impulse, as each brand uses different powder. The author thinks the tight chamber of the AWT rifle was slightly shorter than the Nosler brass's shoulder length. Attempting to utilize a caliper to measure is not exactly a precision technique. I recently dropped, then stepped on my more appropriate tool; much to its detriment. Without the ability to determine the cause of the issue, the author did not fire any more of the Nosler rounds.

The test results are shown in Table 1.

When the test began, the first thing that jumped out at this author was that the rifle did not appreciate most 150-grain projectiles. As it only shot two at what might be considered acceptable groupings, I doubt it had much to do with the ammunition quality or brand. The Federal® Fusion



One round of 150-grain and 180-grain class projectiles.

Table 1: .308 Ammunition Accuracy Test

175/180gr

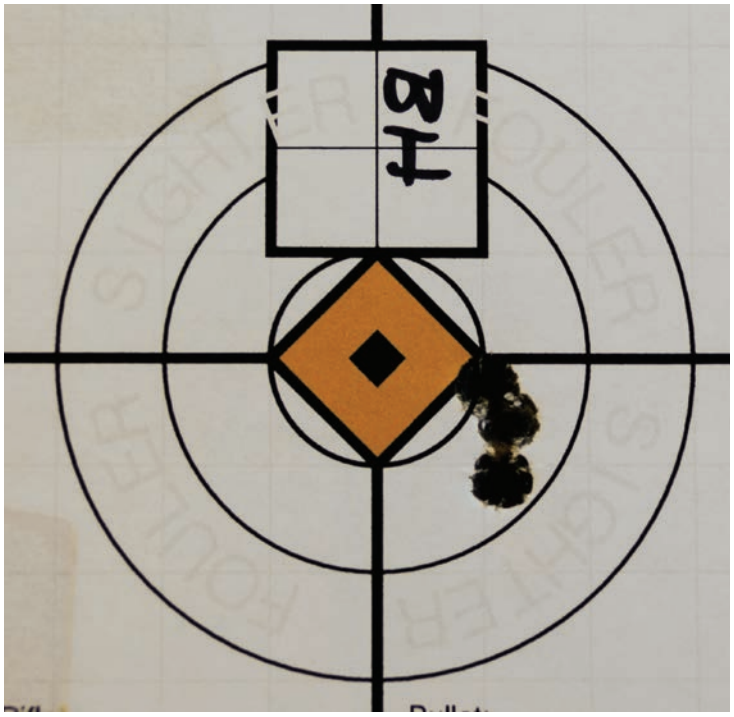
	Best	Average	Worst
Prime 175gr Match BTHP	0.814	1.004	1.709
PMP (South Africa) 180gr Soft Point	0.611	0.783	1.111
Norma BONDSTRIKE 180gr	0.908	1.131	1.262

140/150gr

	Best	Average	Worst
American Eagle 150gr FMJ	3.179	none	4.691
Federal Fusion 150gr JSP	1.486	1.966	2.349
Remington UMC 150gr FMJ	2.856	none	4.831
SIG SAUER Elite 150gr FMJ	2.015	2.351	2.589
ICC Gold Elite TR 140gr JOT Frangible	1.174	none	1.174

168gr

	Best	Average	Worst
Black Hills 168gr Barnes TSX	0.396	0.507	0.698
Federal Gold Metal 168gr Sierra MatchKing BTHP	0.309	0.443	0.645
Federal Premium Gold Match 168gr Sierra MatchKing BTHP	0.365	0.489	0.743
Hornady 168gr BTHP	0.722	0.831	1.016
Hornady Black 168gr Amax	0.585	0.696	0.883
HPR 168gr BTHP	1.466	1.621	2.111
MagTech Sniper .308D 168gr BTHP	1.129	1.396	1.576
Nosler Match Grade 168gr Custom Competition	none	none	none
SIG SAUER Elite 168gr OTM Match	0.398	0.648	0.797



Black Hills 168-grain group.

did moderately well, especially considering it is a non-Match Grade, hunting jacketed soft point. The ICC Gold Elite 140-grain Frangibles also shot decently well, but it was only one group so the data is suspect. The others did not shoot well enough—well, for much of anything except warming the barrel. Had they been soft point instead of FMJ, they were still not "hunting accurate" at 100 yards which would definitely preclude them from much of any use in a bolt gun. Please understand, they may work much better in a semiautomatic, gas-operated gun, as many semiautomatic guns are set up for 150-grain bullets.

I should address the probable reason the lightest projectile seemed to buck the trend of only the heavier bullets performing well. Rifles that like heavier bullets really don't care about the weight. It is just that physics demands a heavier bullet be longer. The ICC bullet being frangible means it has no lead in it. Copper is much less dense (read as lighter) than lead. This means a 140-grain compressed copper dust bullet has to be significantly longer than a 150-grain lead core bullet to attain the weight. It very likely has a similar length to the 168-grain projectiles, which would work better in this rifle.

I imagine if the Fusion had been the 165-grain option, they would have shot tighter groups, but I didn't have any, so we can't say for sure.

The rifle was specifically tuned to shoot the Federal Gold Match 168-grain round. This round is far and away the most common choice for Law Enforcement Sniper use, which is the rifle's purpose. With that in mind, it is no surprise that many of the 168-grain options did quite well. With the exception of the HPR rounds, the boxes all claim to be "Match" ammo. As the chart shows, some companies' ideas of Match include quite tight tolerances and thus tight groups. For others, it must mean they take more care than with their plinking ammo but really aren't serious about true Match quality. The price tends to be a good indicator of "MATCH" vs. "match."

I would like to tell you there was a clear winner; however, there was not. I guess you could count the rifle as the winner, with four ammunition choices that shot groups below 0.400 inch. The four that shot very well all gave fairly consistent performances as well. I should note that shooter wiggle is probably at least 0.100, so any of these four brands could have shot the best group on a different day.

Top Two Performers

	Best	Average	Worst
Federal Gold Medal Match	0.309	0.443	0.645
Federal Premium Gold Medal Match	0.365	0.489	0.743

To the best of my ability to tell the difference (although the packaging is very different), these are different lots of the same ammunition. The SKU number is the same. They also shot the same. To confirm, I shot one set back-to-back and had almost identical groups. The Sierra MatchKing works extremely well, and Federal's loading seems to be quite consistent. Looking especially at the average group size, this is well within the margin of shooter for identical. This also happens to be the round the rifle was designed to shoot; so, no surprise that it shot well. In the hands of a better shooter, I have seen this rifle / ammo combination dip into the mid "2s," at 100 yards. For those who are not aware, my best group would translate to roughly 1.6 inches at 500 yards on a windless day. The higher of the two averages above would be roughly 2.5 inches at the same distance.

Next Two Top Performers

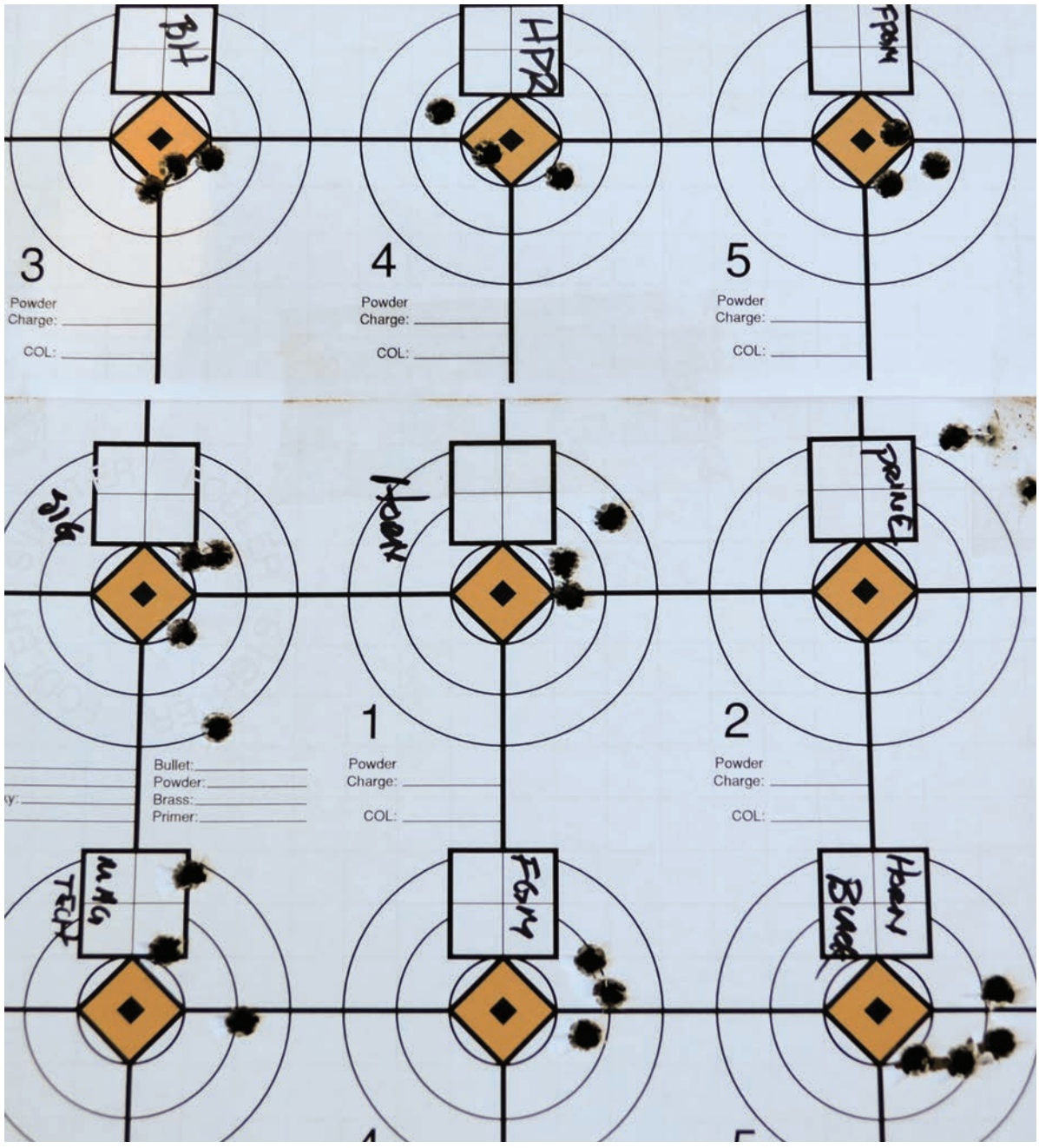
	Best	Average	Worst
Black Hills	0.396	0.507	0.698
SIG SAUER Elite	0.398	0.648	0.797

Of these two, although the best groups are only off by 0.002 inch, the Black Hills ammunition is more consistent with a significantly better average and worst group. Part of that may be due to the Barnes™ TSX bullet. In addition to Black Hills being known as a great company when it comes to quality control, especially on their Match loads, there are few people who complain about the Barnes TSX line's performance. I also don't know many people who would complain about an average group size of 0.650 inch. For that matter, the worst SIG SAUER® Elite group on a windless day is still right at 4 inches at 500 yards. Most people would be very happy with that level of performance.

This leads me to the surprise in the 168-grain contenders. I don't think anyone thinks to add Magtech into the list of Match or Precision ammunition manufacturers' ranks. Don't get me wrong, I am not putting them in contention with any of the top four performers, but for the cost difference:

	Best	Average	Worst
Magtech	1.129	1.396	1.576

I would call these very respectable numbers for ammunition that is priced fairly similarly to the 150-grain choices—especially considering that the 150-grain options shot triple the group size. For perspective, that makes groups of about 5.70 to 7.90 inches at 500 yards. Again, they aren't spectacular groups, but consider the cost savings: Let's just say a 50-round box of Magtech costs about the same as the 20-round boxes of the premium choices, which in this author's mind, makes it a fairly good training round, especially if the shooter (or the rifle) cannot hit the performance numbers of the top four choices. As much as it pains me to quote a Communist genocidal dictator, Stalin was right when he stated,



One round of 168-grain projectiles.

"Quantity has a quality of its own," or perhaps the maxim of "the best practice is doing" is better. Getting 2.5 times the trigger pulls allows for much more range time and that will certainly pay dividends.

Stepping up the weight curve into the 175- to 180-grain ammo, I only had three choices on hand. On the positive side, they all shot well. I was very surprised that a flat, meplat soft point shot the best. The 0.611 group of the South African PMP definitely would not hold up at distance as the ballistic coefficient is much lower, but minimal effect would be seen out to 250 to 300 yards. It also seems to be out of production.

The Norma BONDSTRIKE™ 180-grain was also very impressive. The 0.354-inch difference between the best and worst group is a testament to its consistency, and coming from a round designed for hunting makes it even more impressive. Norma has obviously done good things with their BONDSTRIKE distance hunting line. The worst group should translate to roughly a 6.30-inch group at 500 yards. I would consider that an ethical shot on a deer-sized target given the correct wind conditions; this round is designed to expand at those velocities as well.

Concluding Thoughts

As always, there are things that can skew this test. Different lots of ammo will be slightly different. Your rifle will shoot differently than my test rifle. Your shooting ability is different than mine. Some of you will wonder at how I could shoot so poorly while others dream of ever shooting a 1/3 MOA group.

The points to be taken from this experiment are as follows:

- Test several brands and weights of ammo in your rifle to determine what it tolerates. You may be surprised the difference that can make.
- Shoot several groups and look at the average and the spread between the best and the worst. This is better at determining consistency, which really is the name of the game.

Sending about 250 rounds of premium .308 downrange is spendy, but hopefully the results are helpful for those looking to shoot tight groups. This test should at least point you in the direction of what this author had luck with and a bit on why. SADJ

The Wolverine 5K | It's Anything but Simple

By Josh Wayner

While I seldom write in the first person for this publication, I must make an exception here in so that the reader can experience exactly what I went through from a physical and mental standpoint. Let me say first and foremost that I was in absolutely no way prepared for what is likely the toughest, most grueling and arduous adventure race in the world that is still considered to be a fun event. The Wolverine 5K is unlike anything you've ever experienced, and it was something that took me, a seasoned competition shooter and overall athletic individual, by complete surprise.

To begin this story is to outline the nature of this competition. The Wolverine 5K is an annual event held at the Marksmanship Training Center (MTC) in Lake City, Michigan. For those not native to Michigan, the area is a rather sparsely populated, rural community with its prime season being summer due to a large inland lake and proximity to such famous places like Traverse City and the Mackinac Bridge. The casual vacationer driving upstate will be amazed by the beauty of northern Michigan, but just off the conifer-lined roads is a fearsomely rugged and inhospitable wilderness with vegetation packed so tightly that light hardly reaches the forest floor. It is in these deep, dense areas that the land navigation race took place.

What a non-Michigander must know is just how rapidly the weather changes. The morning began like many others for me before a competition, my belly already full from loading up on carbs and protein the night before, but in the McDonald's® drive thru anyways. June in northern Michigan is still cold, or at least cold by summer standards as compared to the rest of the country. It was nice that it began cool, as the dense tree coverage doesn't allow much breeze when the heat sets in late in the day. The environment of course plays a role in a competition like this, and layers are very important—something I learned by having too few.

The Event

The basic nature of this event is a land navigation 5K race coupled with a scenario-based shooting competition. While that seems very simple, I can assure you it was anything but. Reading and talking to others about the event prior to starting it revealed that most thought of it as a shooting competition with some running, but this is not at all the case. It is in fact an athletic event that blends problem-solving literal puzzles to "reveal" your targets on certain stages, a CrossFit® challenge designed to wear you out, orienteering to question your navigation skills and, for both a large and small part, shooting.

When it comes to shooting, this is what most people heavily focused on, and the gear reflected this. Virtually every competitor I talked to regretted their choices in gear and layout. It was a common sight to see people shifting their pouches around, getting rid of accessories and shedding unnecessary weight. The events change every year, and the idea here is to prevent people from "gaming" the course with specialized gear. I can say with complete confidence that I brought virtually all the wrong gear, save for a few items. I was one of the people shedding weight and parts in the back of my SUV.

I will talk more about gear as this article goes on, but I want to start with the land navigation course itself. After talking with the event organizers, I decided it best to observe this stage firsthand with one of the best four-man teams on the field. I carried my carbine, Hill People Gear pack and harness, pistol, some mags, camera equipment and a 20-pound sandbag just like the rest of the guys I would be running with. The team I was attached to was aptly called "Team America." I was told that I would likely not keep up with them due to the fact that I was

The team figures out a puzzle at a check point. Team America was very fast, usually taking just 2 minutes to solve the target identity and plot a new course to the next point.

a ponytail-wearing magazine journalist who resembled one of those *Wall Street Journal* types. I didn't miss a beat and stayed with them every step of the way and even managed to get some great photos on the way. Keeping up with them was not easy.

When we received the first point to run to, the group immediately plotted a course, and we jogged for around a half mile up the lonely M-66 highway. Only a few cars passed us as we made it up to the point where we needed to go off-road and enter the woods. It turned out that we went a bit too far, and we had to backtrack just slightly, but we found our marker and ventured into the brush.

The woods in this area are thick and dark. There was a point, perhaps just 100 yards, where the density and lack of sunlight make it appear as if it was still night in those places. The woods were oddly silent save for the occasional bird call. We came up to the first checkpoint, and the team began setting up their notes. Prior to the race, we received "intel" packets with codes and "enemy weapons" to identify. These symbols would later provide us with the identification for targets on the 1,000-yard course.

The precision rifle portion saw a great variation in gear. Here a competitor uses a Desert Tech rifle to fire at 1,000 yards.

We continued to the next point across a vast timber burnout, an area that was set ablaze a century ago that created a rolling lowland of skeletonized trunks, young trees and all manner of brush. I saw some large black bear tracks in this area, probably from an animal as large as 600 pounds. Looking to my right, there was a cathedral of trees that abruptly rose next to the burnout, and it was again so dark that I could hardly see into them. Hundreds of deer tracks lined the border of forest and clearing, like a natural highway. The team found the next marker about a third of a mile into the woods, and they set about solving the next puzzle.

After this, we set course into the dark woods. The fern cover was dense on the ground. If you were to kneel, you'd have been invisible. Walking here was treacherous, as there were unknown

A team proudly carried the Stars and Stripes towards the finish line.

amounts of tripping hazards where you couldn't see them underfoot. This trek was slow, and we ended up getting turned around for a moment. The lack of air movement was making me sweat. This trek through the dense woods continued for some time as we ventured into swampy tangles and eventually broke through to some higher ground.

The ground here was loose and sandy. At one point we had to make it up a steep incline of loose sand. That took a great deal of spunk out of me. Walking with so much weight in loose sand is miserable, but there was no slowing down for Team America. At this stage, we were all exhausted. I was going through a pint of water every 15 minutes, but I was sweating it all out, or at least it felt that way.

We arrived at a seemingly endless number of checkpoints and eventually claimed the American flag we needed to bring to the finish line. This was to be carried until the end of the race along with any other items we "liberated" on the way. By this point in time, we had been at a jogging pace for over an hour and a half, and I was about at my end. I only had a moisture-wicking, long-sleeve shirt on, and my gear had begun to chafe me badly. I had bought the shirt the day before I left and never trained with it on. That would not at all be my only mistake that day.

We checked in at our last few points and, having completed them all, grabbed an "ammo can," which in reality was a brick, and brought it to the finish line along with the flag. I was of course sore and exhausted, but I had kept up with one of the fastest teams in the race carrying about 40 pounds of gear on my back. I thought the rest would be a breeze, but I didn't realize that the hardest part of my day had not even started.

No pain, no gain. A tough competitor fell victim to the rough terrain, but duct tape is all it takes to fix gear and broken joints. There was no quit in this group.

I took a break for about a half hour and began to change my gear out. The pack wasn't necessary for the rest of the event, so I removed it from the harness. The Hill People Gear equipment I wore was the best part of my day by a long shot. I had their belt set up with a shoulder harness system, something like a Rhodesian rig. It was light and functional, unlike virtually everything else I brought.

Let's Talk Gear

I want now to get back to my gear discussion. You see, I entered into this competition thinking like a shooting competitor. The real truth of it is that this is not a shooting competition in the truest sense, but rather a problem-solving test using guns. This was not a linear match in any way. I severely underestimated this and brought a full, custom-built Mesa Precision Arms (MPA) carbon fiber 6.5 Creedmoor long-range rifle (far, far too light for the long-range timed shooting I had to do), a Brownells® custom-built AR carbine with a Geissele® 1-6x scope (far too heavy as a total package) and a SIG SAUER 1911 with some custom upgrades. The pistol was probably the only thing I used that was good as-is.

The author's gear load out. The gear was by Hill People Gear, and it was an excellent solution of the rigors it endured. The weapons: Mesa Precision Arms carbon fiber 6.5 Creedmoor with Leupold® VX®-3i LRP rifle scope; Brownells custom AR-15 with Geissele 1-6x scope and Geissele National Match trigger; and a SIG SAUER 1911 with BlackPoint™ holster and Streamlight® TLR-1 HL® light.

In reality, the extensive amount of gear I had was completely unnecessary. If I had to do it all over again, I would have ended up using my heavy 6.5mm target rifle as the long-range rifle. The MPA was perfectly accurate, but it was jumpy on the bipod, and it was hard to spot my shots under a 2-minute timer. This portion was stationary, so there was no point to bring so light a rifle. I had misread the rules and believed that I had to carry all my weapons on the 5K, but this was not the case, and my precision rifle was too light as a result.

As far as the carbine goes, I had that thing covered in more ornaments than a Christmas tree and even had a Service Rifle sling on it. Big mistake. I ended up having to remove the optic to save weight and replaced the sling configuration. I removed just about everything that added ounces. Little did I know when I started, but there were literally one-handed stages and weak-hand courses. My carbine was just too beefy. There was not a single advantage to having an optic on the carbine on any stage. The longest shot for the carbine was just 100 yards. I wished that I would have brought my M16A1 replica instead. In fact, it would have been a much better choice as it is already light and handy. I ended up using iron sights on my carbine for all but the beginning of the competition.

My pistol of choice, the SIG SAUER 1911, was probably the only .45-caliber at the match. Virtually every single one of the 100 competitors had a 9mm GLOCK of some sort with a sprinkling of SIG, STI, Canik and Ruger® in there. I did extremely well on the pistol segments thanks to my familiarity with that pistol, and the range officers took notice, which pleased me. I don't think I would have actually made a change here in the pistol department, but the extra capacity of a 9mm would have been nice at just one point where I had to do a reload.

The general breakdown for most of my competitors was about 90% AR-15 rifles with optics in the 1-4x or 1-6x range. There was at least one FN SCAR I saw, a handful of AK-pattern rifles of various manufacture and features, a 9mm AR rifle and an M14/M1A™. The AR rifles making up the bulk were built by their owners and not factory guns, which goes to show how common building a gun has become. After speaking with many competitors, I found that most shared my sentiments about weight and accessories.

When I removed my scope and began using irons, many people commented to me that they had never used irons and had no option aside from their scope. I did a quick survey and found that only about 10% of competitors I saw had a set of iron sights on their ARs. Optics clearly dominated, but there was some regret. After the event I again spoke to the competitors and heard their gripes about their gear. Most regretted bringing magnified carbine optics. While they are in theory useful, they slowed most people down in shooting and in moving with them. The guys with red dot sights and ACOGs were happy for the most part.

When it came to precision rifles there was a massive variety in calibers and makers. Not one was the same, but there was a clear majority leaning to bolt actions. There were common calibers like .308 and 6.5 Creedmoor but also custom rounds like 6mm Benchrest in use as well. Optics varied wildly, but the majority was of excellent quality. Based on my observations there was a slant to the tactical/PRS features as opposed to target-style features. The precision rifles used here were quite rugged.

Shooting Section

As far as the shooting went, there

The author lights up some targets quite literally with the flamethrower.

was a clear edge to a team of four. The 2-minute limit on the 1,000-yard line was hard for me to work with, and I wasn't able to range and engage all the targets in time, where most teams of four were able to divide the labor among the group and finish on time. Other than that, the target identity course was only at 100 yards. This is the stage where the shooters had to use the "target ID" they collected on the 5K course. A series of unique smiley faces made up a grid where competitors had to use their notes and identify and shoot them. This was where the puzzle solving came in, and many shooters struggled to hit the right face.

The rest of the competition was a scenario-based event based loosely on the "Red Dawn" film. There are too many stages to cover here in appropriate detail, but I will narrate the highlights. One stage featured throwing knives, a bow and a lock you had to pick. Another featured a van that you had to shoot out of with a pistol and dismount to use a rifle. It was almost 180 degrees of shooting which was very fun.

The most interesting stages involved a team of four; if you were alone you got put in with singles or a 3-man team, and you had to shoot targets around a car, steel plates, carry a "dead" comrade in a stretcher and use a flamethrower. Yes, they had a flamethrower competitors got to use on some steel targets. That was certainly an event to remember.

The stage that was a challenge to most competitors was the "jungle run," a 100-yard dash with targets on both sides of a narrow corridor. You had to engage each with two rounds as you ran to the end, and many didn't finish. This was my best run of the day. I had my AR with irons folded down; I just aimed down the barrel and shot point-blank for speed, sometimes less than a foot away from the target. At the end, I dumped the AR and got out my 1911 and did a fast reload to finish with just 1 second to spare! I was very pleased with this.

The last stop of my day was a multi-stage CrossFit-style setup with heavy weights tied to ropes you had to drag then shoot one-handed with your carbine. Three variations of this led to more pain and suffering to an aching body than you'd imagine. At this point in the day, I was so tired and sore that I could hardly hold my heavy carbine up to my shoulder one-handed while pulling the weighted rope. After this there was a tractor tire, probably weighing at least 200 to 250 pounds, maybe more, that competitors had to flip over and then pull out their pistols and shoot a plate. Shooters needed to repeat that five times before moving to a gas-can-carry and rotating-plate shoot. I finished the tire flip, but I failed to make it past that stage. I was completely gassed and deeply regretted doing the hardest stage last.

It Comes to an End

At the end of the day I was done for. My gear felt like it weighed a million pounds, and I could hardly think of anything other than getting my boots off my feet, taking a shower and slamming a six-pack, really in any order. The event was a blast, but I wasn't at all prepared for the toll it took on me, and a large number of my fellow competitors agreed. The most dedicated of the bunch competed for nice prizes, but for the majority were just glad to have finished. Challenge coins were awarded, pats and handshakes were bestowed, and exasperated laughter echoed around the MTC complex.

The nice thing about this event is that it is different every year. The management of MTC spoke to me after the event to talk about next year's challenge. I am informed that the event sells out in just 15 minutes most years, so the ambitious reader had best have his finger on the mouse ready to reserve tickets online. The event is growing, I'm told, and next year the event may be up to 125 to 150 participants; although that is very dependent on the stages and how fast people can be moved through. To prevent people from a gear race, the event organizer, Mr. Ward, assured me that "Practice is irrelevant. You'll be tested." SADJ

ARMAMENT RESEARCH SERVICES

DISPATCHES

Small Arms News from the World's Hot Spots

Improvised trench periscopes.

Improvised Optical Equipment in the Donbass

By Boris Karpa

Amongst the many types of equipment in service with pro-Russian separatists in Eastern Ukraine—whether received from Russia or captured from Ukrainian stocks—communications equipment and optics have been in short supply. These items, notable mostly in their shortage, have been important to the war effort and lamented for their absence. Many separatist and pro-separatist bloggers have commented online that rebel forces experience continuous shortages of all manner of support equipment. Where large-scale supplies could not be acquired by the separatists via "conventional" channels, separatist forces and their supporters had been forced to seek alternatives, purchased by their civilian supporters or acquired via online crowdfunding. In some cases, such alternatives have included craft-produced solutions.

One such item is trench periscopes. Reports from separatist fighters of an increased use of snipers and other long-range small arms engagements by the Ukrainian Armed Forces (whether true or merely rumors) have led to an increased demand for this equipment. As such, the pro-separatist organiza-

A periscope installed in a trench position of the Luhansk People's Republic "Prizrak" ("Ghost") Battalion.

tion KCPN (the "Coordination Centre for Supporting Novorossiya") has organized the production and shipment of improvised trench periscopes in Moscow, by those same volunteers, to separatist fighters near Luhansk.

Once a sufficient quantity of supplies has been amassed in Russia, pro-separatist volunteers will then place them on a private vehicle (a van or small truck) and embark on a journey over the Russian-Ukrainian border and towards one of the capitals of the breakaway republics, and from there, to the positions of the various separatist units.

The quality of the optics mounted in these periscopes varies, and claims of monoculars with x13 magnification have been made in pro-Russian sites. The components (monoculars, compasses and certain other parts) are typically commercial off-the-shelf (COTS) models; although some components may be manufactured by KCPN volunteers in Moscow.

For the periscope mount, separatist sympathizers have also designed a standardized wooden "turret" mount, which allows the periscopes to be raised above a trench position, mounted and dismounted on a bunker's roof without exposing the fighter using the periscopes to small arms fire.

There have been several reports of periscopes being stolen by separatist fighters who rotate away from the front line and take the periscopes with them, so as to ensure that the fighter in question will have the periscope available to him when he returns to the front, even at the expense of other separatist combatants.

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A COTS monocular and a COTS compass, mounted to a trench periscope.

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USMC Selects Elbit's Multispectral Weapon Night Sights

The United States Marine Corps selected Kollsman, Inc.'s solution for a multispectral, clip-on weapon night sight, allowing Marines to engage in day and nighttime operations at extreme stand-off distances. The selection is part of Phase II of the Integrated Clip-on Advanced Targeting Sight (ICATS) program and will require the company to design, build and test two sophisticated ICATS prototypes for the USMC over the next year. Kollsman, Inc. is a subsidiary of Elbit Systems of America.

Elbit Systems of America's ICATS solution is optimized for USMC scout snipers and reconnaissance Marines, so they may acquire targets and engage at extended ranges. The solution clips onto the Marine's weapon and provides critical information to the user, even in low-light or inclement weather. The ICATS is configured to provide simultaneous imaging across extended ranges, without adding considerable weight to the Marine's weapon.

The ICATS solution builds off the company's successes offering the U.S. military other precision targeting capabilities, such as the Next Generation Hand-Held Targeting System for the USMC and the Multi-Domain User Sensor Architecture (MDUSA) targeting system for the U.S. Army. Work on ICATS will be designed and produced in Elbit Systems of America's Merrimack, NH, facility, which is known for its sophisticated electro-optics solutions.

Learn more at **elbitsystems.com.**

Avon Rubber Acquires Team Wendy for $130M

Team Wendy, LLC, a leading U.S. supplier of head protection systems for military, law enforcement, search and rescue and adventure markets, announced that it has entered into a definitive purchase agreement with Avon Rubber p.l.c. (Avon) under which its subsidiary Avon Protection Systems, Inc., a global leader in respiratory and ballistic protection for the world's militaries and first responders, will acquire Team Wendy for a cash consideration of $130 million USD on a cash-free and debt-free basis, subject to a normalized level of working capital. Together, Avon Protection and Team Wendy will create a global leader in head protection systems for the military and first responder markets, following Avon's acquisition of Ceradyne from 3M earlier this year.

The acquisition is expected to close in the first quarter of Avon's 2021 fiscal year ending December 31, 2020, subject to Avon shareholder approval, as well as U.S. regulatory approvals and satisfaction of customary closing conditions. At the close of the transaction, Team Wendy will operate as a subsidiary of Avon from the company's current headquarters in Cleveland, Ohio. Team Wendy will continue to be led by its CEO Jose Rizo-Patron and its six department directors, who will all remain in their positions.

Learn more at **TeamWendy.com.**

Avon Rubber p.l.c.

Team Wendy, LLC, manufactures head protection products such as the EXFIL® Ballistic SL.

STM Expands Exports to NATO with ThinkTech

STM ThinkTech, Turkey's first technology-based think tank, is scheduled to export its products to NATO for the third time in December 2020. Signed in August 2020, the contract for this third project covers the new version of the NATO Resilience Decision Support Model developed by the company to assist NATO's decision-making processes when faced with strategic shocks, such as pandemics, electricity blackouts, cyberattacks and big human movements. Within this project, which is expected to be completed and delivered to NATO December 31, STM is to develop an aggregated model that will assess the integrated resilience of eight NATO countries through open-source strategic shock data.

The new model, known as the NATO SHAPE Aggregated Resilience Decision Support Model, analyzes the effects of large-scale complex problems in support of decision-makers and will be used to make an integrated resilience assessment of eight countries.

The Aggregated Resilience Decision Support Model focuses on the sustainability of aggregated resilience capacity and analyzes the strategic effects of, and the critical changes resulting from, large-scale events and their possible consequences on both civilian and military systems. With the developed model, the effects of different types of strategic shocks in various fields, such as energy, transportation and communication, as well as possible risks, can be analyzed for specific scenarios. This entire process provides NATO with decision support to be made at a strategic level and facilitates decision-making authorities in their choice of the steps to be taken and the measures they can take.

Learn more at **stm.com.tr.**

Quantico Tactical Announces Award for Air Force Special Warfare

Quantico Tactical announced the award of up to $950,000,000 as part of the U.S. Air Force Special Warfare—Multiple Award Contract, SW-MAC, for the Special Warfare Acquisition Group and Refresh (SWAGR) program. The contract was approved by the Air Force Life Cycle Management Center to provide a convenient contract vehicle for Air Force Special Warfare.

The contract is a 10-year Indefinite Delivery/Indefinite Quantity (IDIQ) award to provide equipment, training and product support to approximately 3,500 Air Force Special Warfare operators, as well as authorized users in support of Special Warfare mission requirements. The contract's overall objective is to rapidly procure supplies, provide supply chain management, product training and support and integrate into larger systems in support of mission requirements.

This contract provides support in several areas, including: Assault Zones (AZs) such as tactical zones of action, including drop zones and fixed-wing and rotary-wing landing zones; Fire support—for the contract's purposes, this may include support to ACC-assigned Joint Terminal Attack Controllers (JTACs); Weather data; Personnel Recovery (PR)—for the contract's purposes, this includes the Guardian Angel Mission; Enabling capabilities such as mission management, friendly force detection and geo-locating and rangefinding.

Learn more at **quanticotactical.com.**

True Velocity Delivers "Next Gen" 6.8mm Ammo to U.S. Army

True Velocity officials confirmed recently that the Texas-based technology company delivered more than 170,000 rounds of its 6.8mm TVCM lightweight ammunition to the U.S. Army in May as part of the Next Generation Squad Weapon (NGSW) program.

The U.S. Army down-selected True Velocity's composite-cased ammunition in August 2019 for the NGSW modernization program. True Velocity submitted its 6.8mm composite-cased cartridge as part of an overall NGSW weapon system in partnership with General Dynamics Ordnance and Tactical Systems and firearm manufacturer Beretta.

True Velocity's proprietary composite 6.8mm case design provides end users with significant logistical and operational advantages over metal-hybrid cases and traditional brass cases, including substantially increased effective range and muzzle energy, drastic reduction in cartridge weight and enhanced accuracy, regardless of weapon platform.

The NGSW program is designed to provide the U.S. Army's Close Combat Force with an enhanced 6.8mm cartridge replacement for the currently fielded 5.56x45mm round, as well as to replace the M249 Squad Automatic Weapon and the M4A1 with next-generation weapons.

Learn more at **tvammo.com**.

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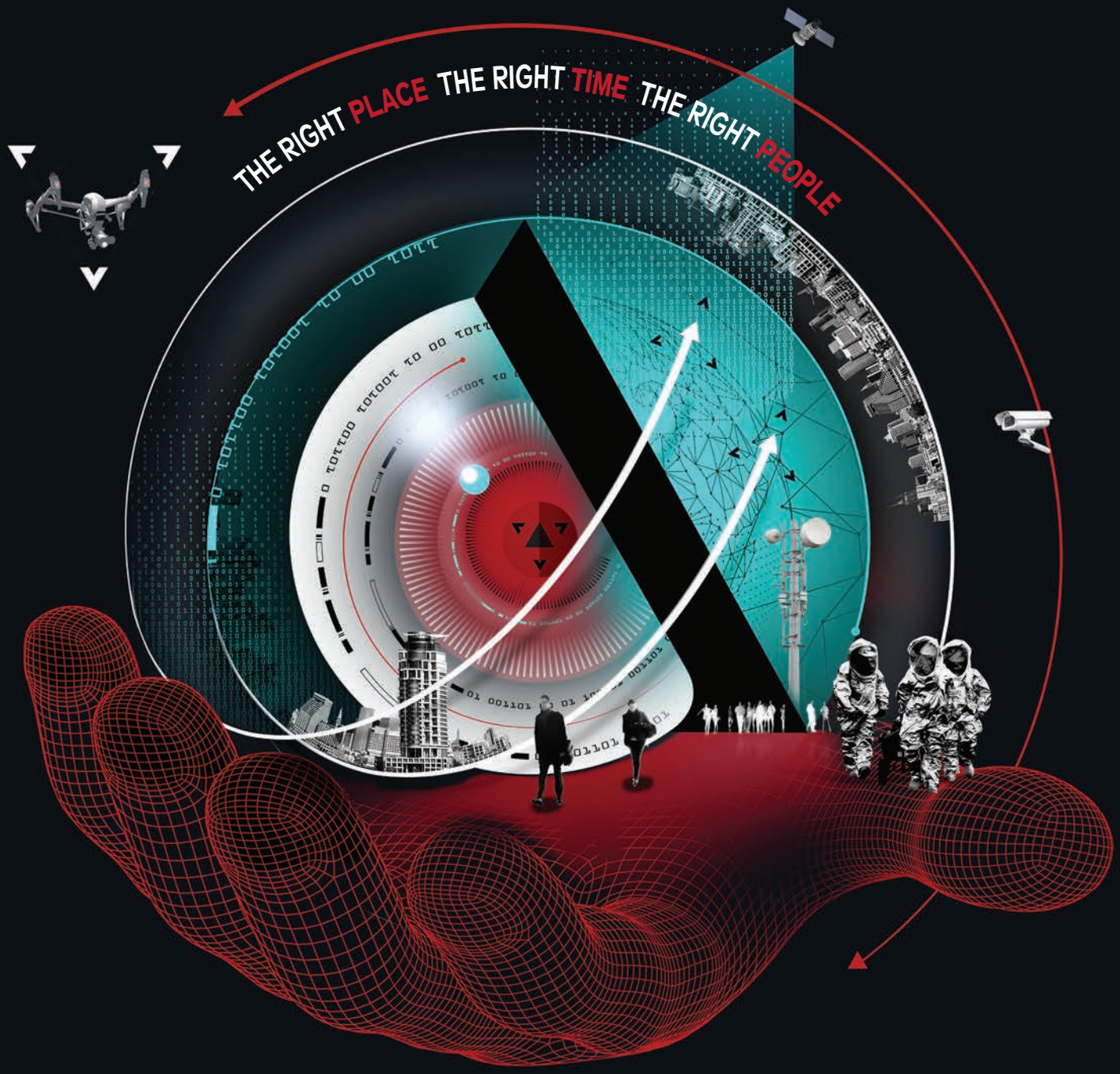

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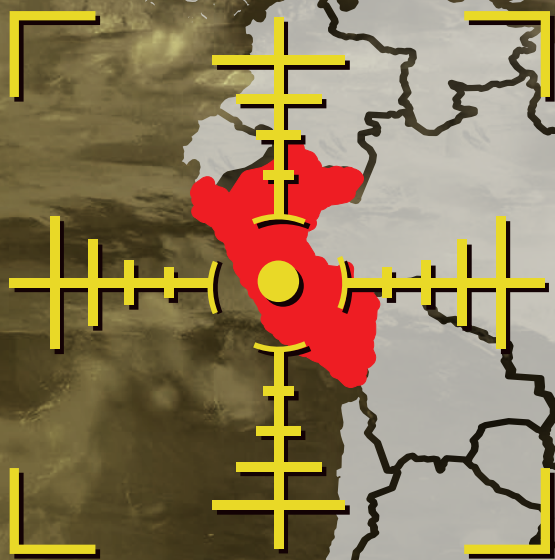

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